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TWO TESTS FOR THE DIAGNOSIS OF OSSICULAR ANKYLOSES, AND INSTRUMENT FOR THEIR PRODUCTION.*

BY EDMUND PRINCE FOWLER, M. D., NEW YORK.

For several years I have been experimenting with tuning forks in the hope that I might ascertain some new facts regarding the interpretation of the various phenomena elicited by their use as diagnostic instruments, and some means of simplifying existing methods of their application.

As one of the results of my investigations, I present to you a modification of the experiments brought out by Gelle in 1881. (Tribune Medicale, October 23rd, 1881). As we all know, Gelle proposed to test the mobility of the ossicles, and especially of the stapes, by noting the diminution in the sound of a tuning fork, vibrating in contact with the skull, when the air in the external auditory meatus was compressed by means of a rubber hand bulb, attached to a tube inserted air-tight into the canal.

He found that if the foot-plate of the stapes was movable, a noticeable diminution in the sound of the fork, or even a total suppression of sound, was obtained with every condensation of the air, and that on releasing the pressure a gradual return to pre-pressure loudness ensued. In primary or secondary affections of the labyrinth the same phenomena manifested themselves, but dizziness or tinnitus were apt to supervene.

Dench quotes Rohrer (Lehrbuch der Ohrenheilk., Vienna, 1891, p. 66), as deeming this test valuable when taken in connection with Rinne's test as follows: Rohrer found that when Rinne's test was negative, Gelle's test was also negative in 73 percent of the cases tested, and that when Rinne was positive Gelle's test yielded positive

*Read before the Section on Otology of the New York Academy of Medicine, November 13, 1908.

results in 88 percent. In all of Rohrer's cases the hearing was much impaired, and probably there co-existed lesions in the middle ear and the labyrinth. Rinne frequently gives negative results in secondary involvement of the labyrinth, and Rohrer believes that Gelle's experiment was especially valuable in this class of cases. In other words, if Gelle is found to be negative, and Rinne gives negative results, the inner ear and the labyrinth are both affected. In cases of severe deafness where Rinne is positive, Gelle is also usually positive, if the labyrinth is involved.

It has been claimed that the Gelle test is dependent not on the increased pressure of the stapes foot-plate against the inner-ear contents, but that it is due solely to the compression of the air within the external auditory meatus, and that the test is of negative value as a diagnostic procedure. I hope that the phenomena to which I shall call your attention will in some measure throw light on this subject.

Owing to the difficulties encountered when one attempts to elicit Gelle's experiment, I long ago abandoned the originator's method of procedure. There are several annoyances with which one has to cope in the older method. In the first place, it is painful to most people to have a tube, though of rubber, inserted into their ear-canals with sufficient pressure to obtain an air-tight joint, and in many, with the greatest care and patience, we fail to prevent a leakage. A tight fit having been obtained, we must entrust its maintenance to an assistant or to the patient if we wish to control ourselves the hand bulb and the fork on the head. We dare not allow the patient to hold the fork, for, if its contact with the scalp is increased or diminished, a change in the loudness of its note will be heard by the subject, and the accuracy of the test will be spoiled. Likewise we must retain the bulb if we would remain cognizant of the amount of pressure being exerted therein. There are three separate things to be done at one and the same time, and but two hands in which we have absolute confidence to do them. To obviate these and other difficulties, I devised an apparatus which I will now describe.

It necessitates the use of but two hands—one to hold it against the side of the head about the ear, and one to control the air bulb. (Before constructing *this* apparatus I used a glass cup with a rubber bulb mounted on its centre, fitting about the ear, as this also simplified matters). It consists of a tuning fork mounted by means of rubber tubing, on a nipple over the central portion of the top of a glass cup or bell. By means of another nipple on its periphery

the cup is joined to the hand bulb by a stout rubber tube, and to insure a better contact soft rubber encircles and overlaps its rim. This latter also makes its application more agreeable to the patient, as it forms a cushion to receive the pressure of the edge of the cup against the head.

To apply the test, place the cup over the ear and so adjust it that no irregularity of the scalp interferes with its even apposition, and to be sure that an air-tight joint has been secured, gently compress and release the bulb, noting any leakage. To better control the pressure of the cup against the patient's head, it is expedient to allow the latter to rest against some stationary object, for few people will resist evenly your pressure on the cup. Having instructed the patient to tell you of any change in the loudness of the note, and having permitted him to listen to it both before and after the cup was adjusted, and also cautioning him not to heed the gradual dying out of the tone, set the fork vibrating. This is most easily and best accomplished by pinching the two prongs between the thumb and first finger of the disengaged hand, and by quickly withdrawing the fingers, allowing the prongs to spring into vibration. After waiting a few moments to allow the fork to steady down, and without changing your pressure on the cup, compress gently the rubber bulb. It is surprising how slight a pressure will elicit the diminution in sound, if the apparatus is correctly used in quiet surroundings.

In normal ears one detects easily a diminution in amplitude on a pressure of less than one millimetre of mercury, and on at once relieving the pressure the sound progressively increases to about its former strength. It is seldom necessary to repeat the experiment more than once or twice to satisfy ourselves that we have obtained accurate data, but, of course, some people are so stupid or their ears are so little trained to noticing changes of volume in musical sounds that it is a hopeless procedure to try to educate them within a few minutes.

Before removing the cup, gently compress the hand bulb, as this guards against suction of the drum as the cup leaves the head, this being occasioned by a partial vacuum within the apparatus, likely to eventuate, owing to some slight leakage during compression.

I hold that the above described method of eliciting Gelle's phenomena is preferable to the established custom, for the following reasons:

It saves time by its simplicity.

It enables the examiner absolutely to control all the manipulations necessary to the carrying out of the test.

It localizes the test to one ear better than placing a fork on the scalp, because the vibrations of the fork on the cup are conducted through the latter's rim to the scalp overlying the bone leading directly to and surrounding the organ under observation.

It is better heard by both bone and air conduction because of the above, and on account of the vibrating cup completely surrounding the auricle, covering the canal and shutting out extraneous noises. The glass cup acts as a resonator and greatly increases the amplitude of the fork's note.

There being nothing inserted into the canal, all danger of traumatism, abrasion, and infection is avoided, and no discomfort accrues to the patient.

The sound of the fork is heard from two to three times longer than by holding its shank against any part of the skull covering, and this, with its increased loudness, is of especial advantage in testing cases with marked deafness, and enables the compression to be repeated several times without again setting the fork in motion. It is usually in marked deafness that there is occasion to test for ankylosis of the stapes.

The very gradual fading away of the tone prevents the misinterpretation of this decrease in loudness for the more sudden and marked diminution brought about by the air condensation.

In nervous cases, less trepidation is occasioned by covering the auricle with the cup than would be by the insertion of anything into the canal.

If through carelessness or ignorance extreme pressure is brought to bear on the hand bulb, there is little likelihood of any harm resulting, as through such a long line of contact as the cup presents ample vent for the compressed air is quickly obtained by the rim being forced away from the side of the head. In the case of the rubber tube in the ear, such escape is not so easily established if the tubing has been tightly fitted into the canal. With ordinary care and pressures, no leakage occurs, and hence no noise of escaping air to confuse the patient and interfere with his detection of the sound change. The apparatus may be used also for other tests, only one of which I will mention at this time.

The machine enables us to bring out an experiment which, as far as I know, has not been dwelt upon as of any value for diagnosis. I refer to the reverse of condensation, namely, rarefaction. With the fork vibrating on the apparatus adjusted about the ear, allow

a little air to escape by compressing the bulb, regain the air-tight apposition of the cup rim to the skin about the auricle, and by releasing slightly the hold on the compressed hand bulb obtain a partial vacuum within the contrivance and external auditory canal. Normal ears under this suction at once note a marked dampening of the fork note, and in proportion to the amount of suction established, until no sound is heard.

On slowly relieving the vacuum the sound gradually reappears. Before removing the apparatus, compress the bulb to release the cup.

The phenomena brought out by the compression and suction experiments are more easily obtained than a satisfactory explanation of their occurrence, but I shall endeavor to impart to you some observations I have made bearing upon the subject, and incidentally, I believe, prove to you that the tests as brought about by my apparatus are quite distinct from those by Gelle.

To guard against errors due to the manipulation of the apparatus, I executed the following experiments and found that,—

For bone conduction, forks are heard best in both ears when placed near the lambda, and when firmly pressed against the scalp. Very strong pressure increases and light pressure diminishes the sound as perceived by the ears under observation for C^2, C^3, and C^4. The reverse may occur with C and C^1 under certain pressures —the sound is localized best in one ear by placing the fork over the mastoid fossa. The ears may be open or closed.

If the ear is closed by a glass cup, with a nipple opening outward, the sound of all forks on the vertex is increased in the same manner as in Weber's experiment, but to a lesser degree. If this cup is more firmly pressed upon, the sound diminishes, and on releasing the pressure the sound increases up to a certain point for C, C^1, and C^2; also with these forks mounted on the cup as in my instrument. For C^3 in both methods of applying the fork the sound increases on stronger and diminishes on weaker pressure.

If the resonator is open, the sound is heard better than when it is closed by the finger over its nipple, and in a lesser degree this holds true if a long rubber tube is attached to the nipple and its distal end opened and closed. These phenomena seem to be due mainly to the contact of the opening or closing device and the pressure of the cup against the scalp interfering with the resonator's vibration, as does the fact that the note seems higher in pitch when the nipple is open.

With the apparatus placed on the scalp, but not about the ear, gentle suction or compression has but slight effect on the loudness

of the tone, because the vibrations of the resonator are dependent on those of its attached fork, and by bone conduction the vibrations are transmitted through the glass practically independently of the changes in the contained air.

Putting over the cup a rubber drum and condensing or rarefying the air inside by means of the hand bulb, brings about but slight variations in the note of the fork attached to the cup, when the latter is held near to but not touching the ear. If a diaphragmed tube is joined to the rubber membrane and inserted into the ear, the vibrations of the apparatus seem increased on either suction or compression. I had a glass resonator constructed with its opening closed by a diaphragm of glass. With a fork mounted on this apparatus no change in its amplitude or tone could be detected on compressing or evacuating the contained air. This is in keeping with the laws governing sound, as density and elasticity, though acting differently, vary under ordinary circumstances in the same proportion. The intensity depends on the density of the air in which a sound is generated, and not on that of the air in which it is heard. The sonorous waves generated within the resonator by its vibration should be increased in intensity on condensation, and diminished on rarefaction, as heard by air conduction, but apparently in my apparatus both of these changes in air density are accompanied by a diminution of sound, and we must therefore dismiss both from our list of factors having decisive bearings on the changes brought out by the apparatus. Other things remaining the same, an augmentation of density always produces a diminution of velocity. Small density and high elasticity greatly increases the velocity of sound waves, and vice versa.

Velocity depends on the elasticity in relation to the density of all media. It is directly proportional to the square root of the elasticity. It is inversely proportional to the square root of the density. On bulb compression the air in the resonator is increased in density and in elasticity, and in temperature, which also increases the elasticity; hence there should be an increase in the velocity. On bulb suction, density and elasticity and temperature are diminished; therefore the velocity of the sound should be diminished, but this temperate change is small and consequently the velocity of the sound is not appreciably affected by the change of density, as the latter is offset by the elasticity change.

A rubber membrane fitted into the external auditory canal so that its movement has no effect on the ear drum, may be compressed or sucked pneumatically, and during either the sound of a fork vibrat-

ing on the vertex seems to be increased in volume. A fork mounted inside of a long cylindrical tube, the orifice of which is closed with a rubber diaphragm, gives a diminished note, if we listen at this end while tensifying the membrane by suction or by compression. If the end opposite the diaphragm is connected by means of a closed glass tube with the external auditory canal, the fork's note is distinctly heard, and compression or suction inside the cylinder increases the amount of sound reaching the listening ear.

These experiments roughly represent what occurs in the ear canal and drum under air and bone conduction tests. The increase in bone conduction is opposed by a diminution in air conduction and vice versa.

With the ears covered or uncovered, and for all forks held on the vertex, mastoid, teeth, or on the resonator about the ear, or heard wholly by air conduction, a marked diminution of sound occurs during strong auto-inflation (Valsalva) or auto-deflation of the tympanic cavity. In like manner, acts suction or compression of the air within the middle ear by Eustachian catheterization. These changes are more apparent with the lower forks; in fact, for C^2 and C^4 it sometimes seems as though an increase was obtained even on quite strong Valsalva or on deflation, and that there were two main factors acting oppositely and striving for supremacy—one to diminish the sound and one to increase it. Such factors may be the compression of the labyrinth through its windows on the one hand and the weighting of the conducting mechanism on the other,—the former tending to diminish and the latter tending to increase the sound as perceived by bone conduction. These factors must constantly be kept in mind during all compression and suction experiments. During auto-suction or auto-compression the sound appears to change (diminish) more if the ears are closed, because in this case the further loading of the ossicles and the increase obtained thereby is largely eliminated.

In old double radicals with patent tubes, where the hearing is almost exclusively by bone conduction, no change is noted in the note of a vertex fork or in that of one mounted as in my apparatus on suction or compression of the air in the ear canals, whether this is accomplished by the surgeon or by the patient through his Eustachian tubes; whereas, in radicals recently operated upon, suction and compression sometimes elicits a change in loudness if the fenestra membranes are as yet sufficiently mobile to respond to the pressure changes.

On making pressure with a probe over the oval window or stapes, a marked diminution in amplitude ensues.

In atrophic cases with relaxed or adhered drums, when no movement can be detected in the malleus on suction or compression with Siegle's otoscope, pressure on the manubrium at once diminishes sound perception, and in some, air-pressure changes with my instrument acting on the flabby drum seems to improve the hearing. This is what might be expected to occur in all ankylosed malleoincal joints with flabby drums.

It is due not wholly to the increased bone conduction, for the better tension may account for the improved hearing by air conduction, as in cases where the hearing is benefited by false drums, collodion cotton pledgets against the drum, or scarification—all of which increase the tension in the conducting mechanism.

The act of swallowing ventilates the middle ear by way of the Eustachian tube, but preliminary to the ventilation a slight deflation of the drum occurs, and I believe this in some measure accounts for the increase in sound, so noticeable in normal ears when swallowing takes place with a fork vibrating on the vertex. If both ears are closed, no increase is noticed. With the ears uncovered gentle auto-deflation or inflation may increase the sound of vertex forks; both usually diminish sound perception if the ears are closed. There are several other interesting phenomena connected with this swallowing experiment, and I hope that some time I may be permitted to bring them before you.

With the ears uncovered and a C^3 fork vibrating strongly on the vertex, a forcible closing of the eyelids causes a marked increase in the intensity of the tone, and for an instant, a slight alteration in pitch, seemingly higher.* With other forks an opposite result is often obtained.

Bringing the jaws tightly together causes a change in the fork's note, but the change is less marked in this case and seems to be due mainly to the increased tonicity of the jaw muscles. The increase noted on eye closure would appear probably to be brought about by the loading of the conducting mechanism outweighing the intralabyrinthine influence of the stapes foot-plate movement, for, heard by air conduction before the ear, the sound is diminished in intensity.

The above experiments are best elicited by using forks C^2 and C^3, strongly vibrating, and the change in sound is probably caused by

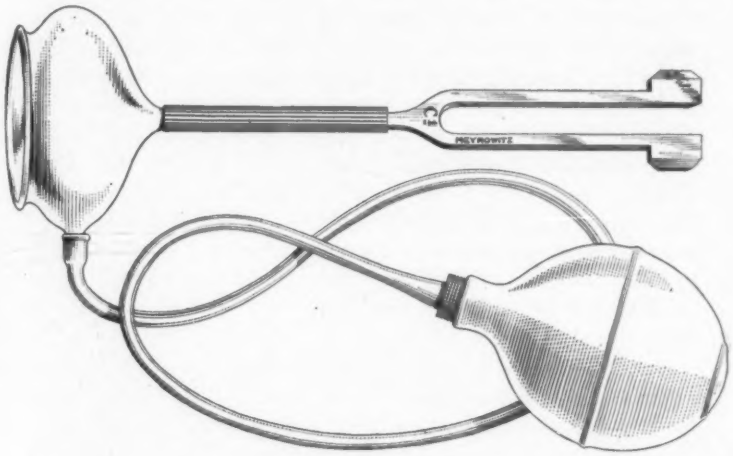
*In attempting to forcibly close the eyelids, it should be noted that it is practically impossible to avoid contractions in muscles of other localities, and especially of the pharynx.

the contraction of the stapedius lifting its burden out of the oval window, and the tensification or loading of the conducting mechanism, the latter predominating in influence.

By means of a tight-fitting double auscultation tube, amplitude changes may often be heard by the examiner.

With the ears closed with resonators, all forks, whether on the vertex, mastoid, teeth, or on a resonator over the ear, are heard less distinctly on forcibly closing the eyelids, and the pitch of their notes appears somewhat raised.

In this case, there is a dimming of the sound, as the influence of the tensified ossicles and drum is sufficiently eliminated by the



preliminary covering up of the ears, thus preventing perception of the increased bone conduction. Bringing the teeth into strong apposition does not so act.

During compression with my apparatus or during strong Valsalva, the sound of vertex forks is increased on forcibly closing the eyelids, and likewise during suction or auto-deflation.

During auto-deflation with a fork vibrating before the ear, its sound is little changed (apparently weaker) on closing the eyes, but during Valsalva a marked decrease in sound is apparent.

During compression, the sound of a fork on the head or on a resonator is increased by Valsalva and diminished by auto-deflation. During suction, the sound is increased by auto-deflation and diminished by Valsalva.

For the moment, let us eliminate from our consideration air conduction, and argue as follows:

On Valsalva, although the drum and manubrium are carried outward, they do not to any extent draw after them the incus or stapes, on account of the ratchet-like cog between the articular surfaces of the latter ossicles. But the air pressure depresses the membranes covering the oval and round windows and therefore also affects the endolymph.

During compression by the hand bulb, the labyrinth structures are affected by the increased pressure in the middle ear, and also and more markedly by the pushing inwards of the stapes foot-plate by the excursion against it of the incus, malleus, and drum.

During either of these conditions, on forcibly closing the eyes, the stapedius contracts, and so tends to lift the foot-plate and slightly lessen the pressure in the endolymph. Furthermore, the increased tension in the conducting mechanism causes an increased perception by bone conduction.

This increase is much more apparent under Valsalva than under bulb compression, for during the latter the ears are covered by cups, and hence the increase due to better bone conduction is limited, and the existing strong tension between the stapes and its neighboring structures prevents the comparatively slight increase in tension brought about by stapedius contraction from exerting any appreciable effect.

During suction both fenestra membranes are drawn outward, and a diminution in labyrinthine pressure ensues. The contraction of the stapedius under these conditions must augment the tension in the stapes annular ligament, and on its distal side as a fulcrum the foot-plate is pushed in, thus releasing slightly the negative pressure in the endolymph and increasing the tension in the conduction mechanism.

Auto-deflation acts, so far as the stapes is concerned, much like compression, and on the round window like suction, hence on closing the lids a like but more marked result is obtained, largely because the increased bone conduction is allowed free play.

During auto-deflation with both ears closed, it is very difficult to note any change in the sound of the vertex forks on closing the eyes. Likewise, during auto-deflation and the fork heard by air conduction, little sound change is manifested on eye closure, as no increase by bone conduction can occur and the slight change in tension is barely sufficient to further lessen the perception of the tone.

On the other hand, during Valsalva, the increased tension in the conducting mechanism caused by the slight movement in the stapes during eye closure tends to better approximate the ossicles for air conduction, and a noticeable increase in sound ensues.

During compression an increase occurs on Valsalva, because in spite of the higher pressure in the middle ear and on the cochlear windows a lesser pressure is really brought to bear on these on account of the outward forcing of the drum and malleus handle, and necessarily therefore a much greater diminution of stress on the stapes window than could be counterbalanced by the slight increase in condensation due to Valsalva.

In like manner, during compression auto-deflation brings more pressure to bear on the stapes than can be equaled by the relaxation of the pressure and the suction on the membrane covering the fenestra rotunda, and consequently sound perception is diminished.

During suction Valsalva diminishes the sound still further because, although it relieves the vacuum in the middle ear and condenses the air, it increases the separation of the lower part of the malleo-incal articulation, increases the tension of the ossicular ligaments and drum, and does not allow the stapes to regain its position.

Auto-deflation does just the opposite, and increases the sound thereby, and also by the replacement of the stapes into position by the inward excursion of the ossicular chain.

Now although the foregoing arguments seem plausible, let us see if we can entertain them when keeping in mind the fact that the same phenomena occur during the fading away of the forks' note when my apparatus is used, as the hearing is then almost wholly by air conduction.

This likewise holds good if the apparatus with an internally mounted fork is used, and seemingly the changes noted do not differ from those observed with my other device.

The important element that air perception adds to the phenomena described in normal ears is that on increased tension air conduction is diminished and that on the return to normal tension it is increased.

This diminution or increase is added to that brought about by the pressure changes in the inner ear and the disturbed malleo-incal joint mechanism.

The question remains—to what extent does the increased bone conduction counterbalance the diminished air conduction during the pressure changes?

I hold that they balance one another, at least in sufficient degree to enable the increased labyrinthine pressure to determine the sound changes during the test, and that the controlling factor in suction experiments is the varying tension in and between the elements of the conducting mechanism, and especially that between the malleus and incus.

I have many times executed the following experiments to prove that in normal ears the dimming of sounds was due to the pressure changes in the labyrinthine contents when all movements of the drum or ossicular chain were eliminated.

Place a fork on the vertex—or on my resonator over the ear—and fix into the ears hermetically a double stethoscope connected through a Y-tube with one leading into the mouth and nostril. After the fork is vibrating, close the nostrils, blow into the mouth tube, and thereby bring to bear on both sides of the drum an equal air pressure. Note the diminution of the fork note, and when sure that the pressures are equal remove the fork from the head and allow all pressure to cease, and immediately replace the vibrating fork. Its sound will be easily perceived, louder than before.

With the same fork and ear arrangement, but with a nose-piece replacing the mouth-tube and inserted air-tight into one nostril, close the other nostril and create a partial vacuum within the nose, the apparatus, and on both sides of the drum, by attempting to inspire through the nose. The palate must be trained to properly tensify so as to open and keep open the tubes in these experiments.

After noting the sound change, and assuring yourself that the pressures are equal, remove the fork, and before replacing it release all suction and remove the residual air from the middle ear by swallowing or opening the tubes. On immediately replacing the fork a marked increase in its sound is noted.

These experiments suggest a method of testing exclusively for the movability of the labyrinth window membranes, but obviously, until some other means can be found for their performance, they will be impracticable for most people to execute.

If we carefully consider the modus operandi of all the experiments I have described, we will—I feel confident—come to the conclusion that suction or compression of the middle ear and conduction mechanism causes diminution in tone perception about as outlined, for no matter what the influence of the varying conditions in the apparatus may be, the changes in sound perception can always be explained by the increase or diminution in labyrinthine

pressures or by the predominating effect of changed air and bone conduction in the middle ear structures.

Of course, it is apparent that the changes within the resonator must either accentuate or interfere with the results of all experiments conducted under its influence, but this interference is not to my mind the determining factor in the tests explained, as it is often in spite of these influences that the effects are produced.

At the risk of tiring you, maybe, I will recount one more experiment.

Execute the compression test with the apparatus connected up to a mercury double tube monometer, and maintain an even pressure of thirty millimetres (or more) for from eight to ten seconds—at the end of which time quickly diminish the pressure a few millimetres and return to the former pressure. Under these conditions the fork's note, instead of sounding louder during the release of pressure, often appears a little diminished, and in place of diminishing on the return of the stronger pressure its note appears more intense or to remain stationary. I can account for the above only by assuming that the prolonged pressure allows the endolymph to adjust itself to the novel conditions, and that a quick diminution and return act faintly but similarly to these changes from the normal tensions. On prolonged suction similar anomalies do not manifest themselves, perhaps because under suction the main disturbing factor is the separation of the odontoid processes of the malleo-incal joint.

In diseased middle ears the conducting apparatus is always overloaded, and therefore the sound of the tuning fork must be heard more by bone conduction and less by air conduction than normally. This being the case, it appears to me to greatly further my point of view as to the reliability of the tests, for it tends to eliminate sound heard through the air, and also, but to a lesser degree, the variations in sound waves reflected back to the labyrinth from the diseased conductors thereto—and the more serious the condition of ankylosis the more our tests are concentrated upon the detection of stapes and malleo-incal movability.

Fearing that I have tired you by a too minute discussion of the foregoing, I desist from further elaboration of the many disturbing factors which enter into the sound changes, or the established laws governing sound phenomena, and will close my paper with a statement of my present belief in regard to the reliability of the tests described.

I do not wish to imply that my opinions are settled absolutely, for I crave more knowledge on the subject, but I believe that when its technique is mastered, my test founded on Gelle's experiment and the suction test as described are together of real value in diagnosing and differentiating stapes fixation and malleo-incal ankyloses from other inhibitions of ossicular mobility.

I believe that if the suction or compression tests produce increases in sound perception, it is almost certain that treatment should be directed toward the better tension of the ossicles or drum.

I also believe that the amount of pressure or suction necessary to bring out the diminution in sound is a gauge of the pathological processes presenting, and that the presence or reappearance of a positive response to either suction or compression is a valuable and welcome prognostic sign.

No. 57 West 76th Street.

Remarks upon Thyreotomy. LUDWIG LOEWE. *Monatsschrift f. Ohrenheilkunde,* August, 1905.

From an experience of nine cases Loewe draws the following conclusions:

The indication for thyreotomy does not depend upon the question of malignancy, but is entirely dependent upon the amount of tissue to be removed from the interior of the larynx.

Local anesthesia with Schleich's solution was entirely satisfactory in one case.

The Trendelenburg canula was unreliable. The best procedure consists of surrounding a sponge canula with iodoform gauze.

Suture of the cartilage is impracticable. Suture of the soft parts is sufficient. The entire wound is sutured.

A stomach-tube may be inserted as far as the cardia before opening the larynx. It is left *in situ* for three days. It prevents vomiting into the wound and facilitates feeding.

The position of the patient as recommended by Semon is not important. YANKAUER.

THE FORM OF THE HARD PALATE.*

BY HARRIS PEYTON MOSHER, M. D., BOSTON.

The subject of this paper is the form of the hard palate. I shall discuss it under the following headings:

I. The four types of the hard palate.

II. The normal form of the palate.

III. The part played by the alveolar process in making the normal arch.

IV. The causes of variations from the normal form, which are:

1. Mal-occlusion of the teeth.
2. Unequal growth between parts of the septum.
3. Low descent of the antra.
4. Faulty shrinkage and faulty re-adjustment of the premaxillae.
5. Asymmetry of the halves of the palate.

The most important and so the central idea of the paper is that asymmetry between the halves of the palate is due not always to asymmetry of the head as a whole, but is due nearly as often to asymmetry confined to the bones of the face. Accompanying the inequality in the two sides of the palate there is almost always a vomer spur and a deviation of the septum. When the asymmetry is confined to the face, the teeth are the chief cause in producing it.

Asymmetry between its halves is one of the most important variations in the form of the palate. Since in fifty per cent of the cases this is part of a general asymmetry of the head, it is necessary by way of introduction to refer briefly to the subject of asymmetry of the skull as a whole.

Asymmetry of the Skull.

The most frequent irregularity in the form of the skull is want of symmetry. Probably no skull is perfectly symmetrical. The condition which has been observed to exist most frequently with irregular forms of skull is premature closure or obliteration of cer-

*Read at the Meeting of the American Laryngological Association, Montreal, May 11, 1908.

The specimens which furnished the foundation of this paper are from the Laboratory of the Anatomical Department of the Harvard Medical School. The clinical cases, the impressions of the palate and the X-Rays are from the Throat Department of the Massachusetts General Hospital.

For help in making the casts and impressions of the palate and the brow I here express my thanks to Dr. Isabella D. Kerr.

The illustrations were drawn by the writer.

tain sutures. The cranial bones increase in size mainly at their margins, and when a suture is prematurely closed, the growth of the skull in the direction at right angles to the line of suture is checked and increased growth takes place in other directions in order to supply the defect. For instance, in cases of obliteration of the saggital suture the transverse growth is prevented and compensatory growth takes place in a vertical direction, resulting in the scaphoid or boat-shaped skull. Similarly, in obliteration of the coronal suture compensatory growth takes place mainly upwards. Oblique deformity of the skull occurs with premature closure of one half of the coronal or lambdoid suture. Independently of this a like deformity may be produced by rickets or wry-neck.

Not only may premature closure of sutures cause asymmetry of the skull but pressure artificially applied in early life may do so. This is best shown in the skulls of Flat Head Indians. These tribes had the well known custom of compressing the heads of their children by an apparatus of boards and bandages. This resulted in severe deformity.

Asymmetry is illustrated in a slighter degree by individual instances where undue pressure has been employed unintentionally. Distortions likewise occur in long buried skulls which have been subjected to pressure and moisture. (Quain Vol. II. Part I, p. 85.)

Differences in the Skull According to Age.

In order to properly appreciate asymmetry in the skull it is necessary to bear in mind the normal periods of growth and to know the differences found in the skull according to age. The most striking fact is that at birth the head is chiefly skull and but little face. At birth the face is scarcely an eight of the bulk of the cranium, whereas in the adult it has risen to one-half. In the first seven years the skull grows rapidly so that during this time certain parts of it, namely the circumference of the occipital foramen, the body of the sphenoid, and the petrous portion of the temporal bone have attained practically their adult size. The other regions increase but little until the period of the second dentition. With the coming of the second teeth the accessory sinuses enlarge, and in consequence of this the face begins to grow. The growth of the face is due in part, however, to the increased height of the nasal fossae, to the enlargement of the alveolar arches and the growth of the teeth. By puberty no difference

between the size of the skull and the face has in a great measure disappeared. X-ray plates show that the sinuses can be of adult size at puberty.

In old age the skull becomes lighter and thinner. Often it is a little smaller. In some cases, however, it increases in thickness and weight owing to the deposit of bone on the interior of the brain

Fig. 1.

Congenital Occlusion of the Right Choana, resulting in lack of full development of the right side of the head and face. (Courtesy of Dr. Coolidge.)

case. The proportion of the face to the skull is diminished by the loss of the teeth and the absorption of the alveolar processes of the jaws. In consequence of this the upper jaw recedes and the lower jaw comes forward. (Quain, Vol. II, Part 1, p. 82.)

How Asymmetry of the Skull Is Shown.

Asymmetry shows itself in the face externally by unequal width of the two halves, by unequal height of the eyebrows and by deviation of the nasal bones and of the nose. In the internal structure of

the face asymmetry is shown by unequal size of the antra, by inequality of the nasal fossae, and by the unequal height of the two halves of the hard palate.

In many cases the asymmetry includes each half of the head as a whole, in other cases casts indicate that the lack of parallel growth occurs only in the bones of the face. My observations go to show that asymmetry confined to the bones of the face is common, and but a little less so than asymmetry of the head as a

Fig. 2.

Congenital Occlusion of the Right Choana. Side view.

whole. When you stop to consider the conditions which can cause asymmetry of the face, you find that there are more which are common to the face than to the skull. The development of the face depends upon the expansion of the accessory sinuses, and the development of the sinuses depends upon the teeth. The face is made for the teeth and by the teeth. There are two sets of teeth and the bones of the face are concerned with the development and eruption of these two sets for the first twenty years.

I wish at this point to give an example of the two chief forms of asymmetry of the skull.

1. Asymmetry of the whole half of the head. (See Figs. 1, 2.)

This photograph is taken from a boy of 17 who had congenital occlusion of the right choana. He is a patient of Dr. Coolidge. The picture shows that the right half of the head and the right half of the face are smaller than the left half of the head and

Fig. 3.

Photograph of a case of Asymmetry of the Palate (Tuttle). The right side of the palate is higher than the left, but the asymmetry does not show in the face. Front view. See figures 4, 5, 6, 7.

face. A cast made of the brow and one made of the occiput show the same differences between the right and left sides of the head as are shown in the photograph. An impression of the hard palate shows that the right side is higher than the left. The septum is deviated to the right with a marked vomer spur on the left.

2. Asymmetry of the two halves of the face.

In this case the right half of the face is less developed than the left. The impression of the palate shows that the right half is the higher, and the X-ray shows that the right nasal notch is higher than the left. In the cast of the forehead the right frontal sinus is more prominent than the left, but the two frontal eminences are equal. In other words, the asymmetry stops with the frontal sinuses. The frontal sinus is really a part

Fig. 4.

Photograph of a case of asymmetry of the palate (Tuttle). Side view.

of the face. It begins to enlarge with the coming of the second dentition, at the same time that the antrum enlarges, and from now on its growth is intimately related to the growth of the antrum. Usually in asymmetry of the face the superciliary ridge on the side of the palate which is the higher is more prominent than the other, and the frontal sinus of this side is usually the larger. (Figs. 3, 4, 5, 6, 7.)

What I have said about the general subject of asymmetry of the head has been necessary because asymmetry figures so largely in certain important variations of the form of the hard palate. I come now to speak of the form of the palate. In the palate we have to do with two arches, the arch made by the palatal processes of the palate bones and the superior maxillae and the arch made by the teeth. Both the palatal arch and the dental arch are equally important in determining the form of the palate. Of both there are four types.

Fig. 5.

Impression in modelling compound from a case of asymmetry of the halves of the palate. In this instance the right side of the palate is higher than the left.

The Four Types of the Dental Arch. (Fig. 8.)

1. The curve described by the dental arch is quite variable. These variations have been classified according to temperament. This is a rather loose, unscientific method, but quaint and expressive and undoubtedly has a certain amount of truth in it. In the first type the dental arch is well rounded anteriorly, the circle being continued backward through the region of the molars. The distance in a straight line from the center of the second

molar on one side to the center of the corresponding molar tooth on the other side, is about equal to the distance from either of these points to a point in the median line between the central incisors. Such an arch is found according to the old phraseology in connection with the sanguine temperament.

Fig. 6.

View from above of the impression figured in No. 5. Notice that on the right side, which corresponds to the high side of the palate the dental arch is almost a straight line while on the other side it has its normal curve.

2. The second type of arch is narrower than the first and is shaped more like the three sides of a parallelogram. It is almost straight across in front and the sides run back with very little curve. The inter-molar line is much reduced in length. The old name for this is the bilious type. (Fig. 9.)

3. The third type of arch is the angular. In this the two sides of the arch are straight lines, not curved or bowed and in front they almost meet in a point. The segment of the arch made by the anterior teeth is much smaller than in the other two types and amounts to but little. The line between the molars is much shorter than the line to the space between the incisor teeth. The old name for this type is the nervous. (Fig. 10.)

4. The fourth type of arch is an arch made like the first, of two equally bowed halves. It is simply a wider and larger form of the first type. The arch is well rounded and broad, the segment being that of a much larger circle than is found in any of the other types. The inter-molar line is longer than the molar-incisor line. The old name for this is the lymphatic type. (Broomell, p. 106.) (Fig. 8.)

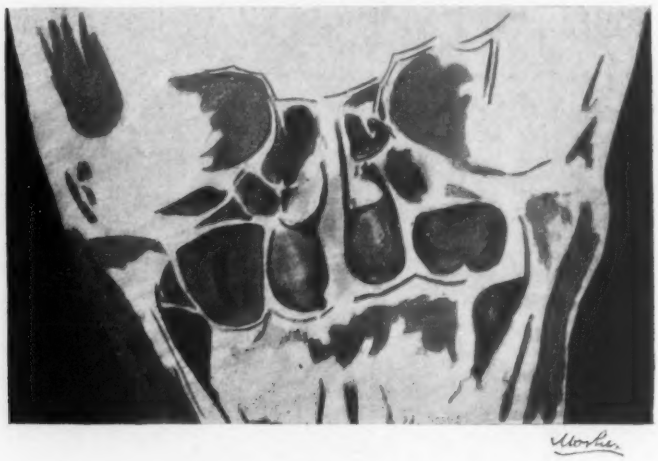


Fig. 7.

Tracing from an X-Ray of a case of Asymmetry of the Palate. The plate is looked at from behind. The right side of the palate is higher than the left. (Tuttle.) The asymmetry in this case is confined to the face. Figures 3, 4, 5, 6, 7 are from the same case.

The Palatal Arch.

The palatal arch is practically a duplicate of the dental arch. It occurs in the same four types. If the dental arch is reproduced in wire and this wire is placed upright like a wicket, the upper half of the wire would represent the palatal arch and the lower half the alveolar process and the teeth.

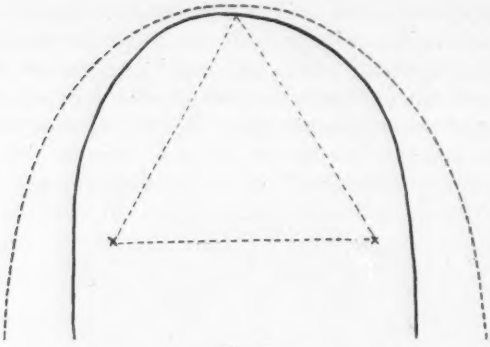


Fig. 8.

The dark line represents the dental curve of the normal palate. A palate which has this curve is classed as Type No. 1. The dotted line represents diagrammatically the wide form of palate, or Type No. 4.

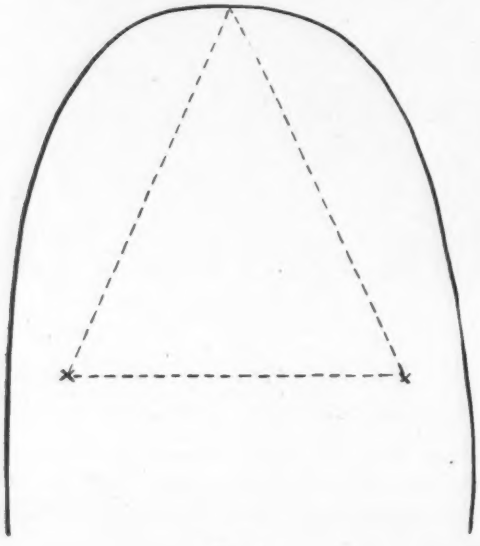


Fig. 9.

Type No. 2. The Quadrilateral Palate.

The Normal Arch.

Heads group themselves into two classes; the high narrow head, and the short broad head. In the high narrow head the arch of the palate tends to be of the second or third type, that is, it is

high and narrow, and has the parallelogram or the acute angle for its geometrical basis. The short broad head has a wide, flat, equally curved arch more like type four. The ideal and so the normal arch is a smaller form of the fourth type. Such an arch is represented most nearly by type one. This type as you remember is supposed to be associated, according to the old and prettily descriptive phraseology, with the sanguine temperament. In a way however, each of these four types is normal for a certian type of head. (Fig. 8.)

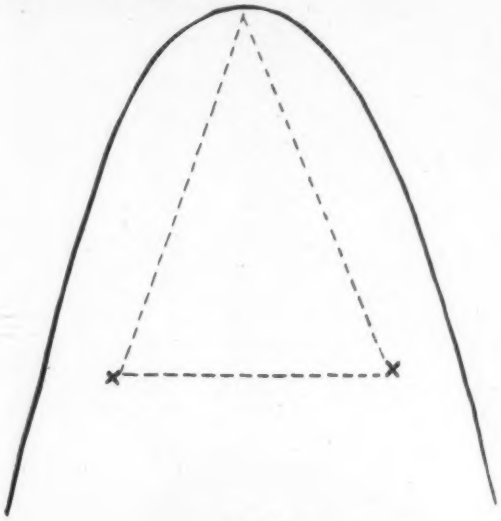


Fig. 10.

Type No. 3. The V-shaped or Angular Palate.

The Palate Seen in Longitudinal Section.

A longitudinal section of the hard palate at birth shows that the median line gradually rises and reaches its highest point about a third of the distance back. From this point it slopes a little downward. This downward slope of the posterior two thirds of the median line of the palate is found up to ten years of age. In the adult the highest point of the palate occurs between the first and second bicuspid teeth or between the second bicuspid and the first molar. From the highest point the normal adult palate does not slope downward as happens in the infantile palate, but continues backward in a horizontal line. The highest point in the arch corres-

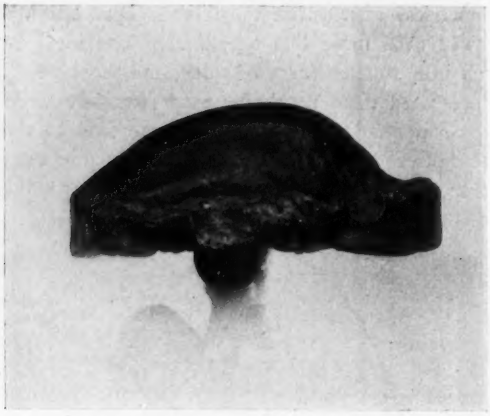


Fig. 11.

Side view of the palatal arch of a boy of twelve years. Notice how the line of the palate after reaching its maximum height about a third of the distance back slopes gently downward for the rest of its course.

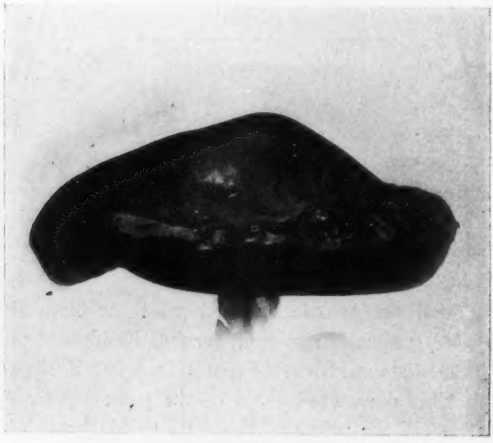


Fig. 12.

Side view of the palate of a negro boy thirteen years of age. Notice that the highest point of the arch comes about half way back instead of a third of the distance back as is the usual custom. Behind the highest point the line of the palate slopes downward very markedly. The steep slope of the posterior half of the arch is an infantile characteristic.

Fig. 13.

Front view of a noticeably square form of arch from a young man of eighteen years of age.

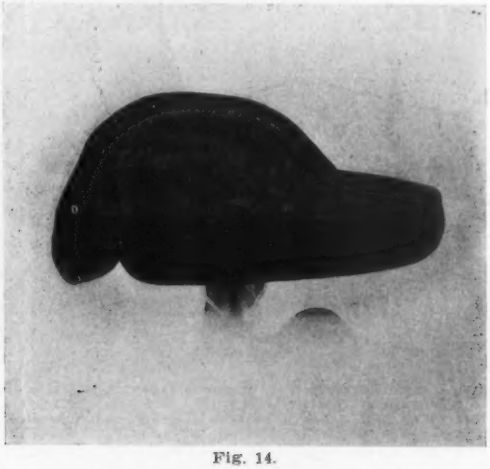
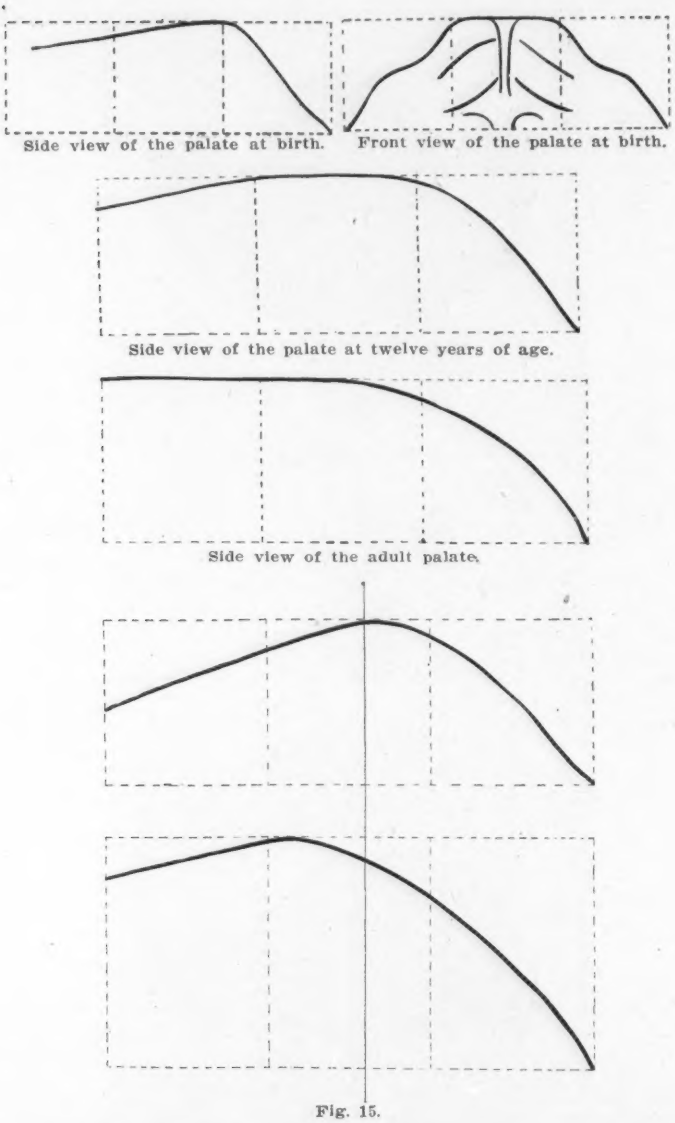


Fig. 14.

Side view of the same arch which is shown in figure No. 13.



Side view of the palate at birth. Front view of the palate at birth.

Side view of the palate at twelve years of age.

Side view of the adult palate.

Fig. 15.

Of the two lower diagrams the upper one represents the side view of the palate of a negro boy thirteen years old. The lower drawing represents the side view of an adult negro palate. The second palate is a marked example of the V-shaped arch. The diagrams are larger than life size.

ponds in the adult to the anterior limit of the fully developed antrum. In herbiverous animals there is a toothless space between the incisor teeth and the premolars. This gap is not conspicuous in carnivora but it is never wholly obliterated until man is reached. This gap or the diastema, as it is called, corresponds in man to the highest part of the palate. Roughly speaking, the portion of the palate in front of the highest point is made from the premaxillae, and the portion of the palate behind is made from the superior maxillae. If you start with the flat animal palate and trace the changes which have occurred in the palate down to man, you find that one of the greatest changes is the tilting downward of the premaxillae. The bending downward of the premaxiilae and their proper shrinkage is accomplished to a certain extent in monkeys, but is not accomplished fully except in man. (Figs. 11, 12, 13, 14, 15.)

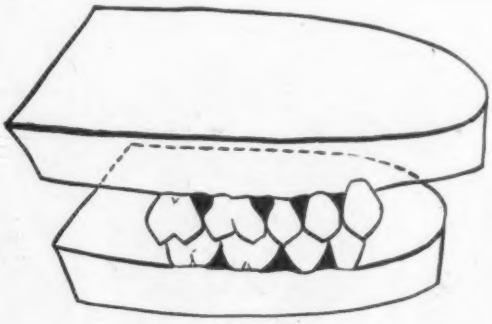


Fig. 16.

Diagrammatic drawing to illustrate the occlusion of the teeth.

The Part Played by the Alveolar Process in the Formation of the Normal Arch.

In the normal palate the alveolar process is responsible for much of the arch effect. If the teeth are lost and the alveolar process is absorbed the arch in a great measure disappears. When the teeth are long and the amount of the alveolar substance about their roots is small, the arch of the palate appears to be high. In such a palate the roof rests upon the half naked tooth roots as if supported upon stilts, and the lines made by the half bare tooth roots stand out clearly on the sides.

The mounding of the alveolar process about the teeth may be compared to the mounding of earth about celery stalks. The

higher the earth is piled about the celery the deeper the furrow between the rows. When the celery is pulled up the earth falls in and the ridge which it formerly made is partially obliterated and the furrow between any two rows becomes less deep and the sides less steep. The likeness between the behavior of the earth mounded about two rows of celery and the halves of the alveolar processes of the superior maxillae and the premaxillae is almost perfect.

Fig. 17.

Tracing from an X-Ray of a case of high V-shaped palate due to narrow nasal fossae and to low descent of the antra.

In certain animals we have a chance to see how much of the arch of the palate depends upon the alveolar process. The Great Ant Eater, as you know, is distinguished by his long cane like snout and the absence of teeth. The palate of the Ant Eater is absolutely flat. The palate of the bear with the teeth extracted is flat, except for a slight tendency to arch formation where the alveolar process mounds down to support the very large canine

teeth. In herbiverous animals that have large and complicated molars, the palate has posteriorly a distinct transverse arch. This is made by the mounding down of the alveolar process about the molars so that they may be firmly supported for the heavy grinding which they are called upon to perform. There is no arch about the anterior teeth. The teeth of a bear and of a dog are used mostly for grasping and tearing and have but little mounding of the alveolar process about their roots, and so the palate in these animals is not arched.

The Palate At Birth.

There are no teeth at birth; nevertheless, the palate has a very marked arch. It would not seem as if the alveolar process could play any part in the formation of this. However it does, though a bit indirectly. There is no such thing as a toothless baby. Only an adult can be really toothless. At birth the alveolar process is filled to bursting with two sets of tooth germs. Owing to this the alveolar process mounds down into a ridge on either side of the palate and makes its share of the palatal arch just as much at birth as in the adult. The teeth at birth mound down inside of the alveolar process instead of outside of it. (Fig. No. 15.)

So far I have described the usual types of the alveolar and palatal arches. I have described the characteristics of the normal arch and brought out the importance of the alveolar process in making the normal arch. This brings me to the next division of my subject, the causes of variation from the normal type. These, as I stated at the beginning of the paper are:

1. Mal-occlusion of the teeth.
2. Unequal growth between the parts of the septum.
3. Low descent of the antra.
4. Faulty shrinkage and faulty re-adjustment of the pre-maxillae.
5. Asymmetry of the halves of the palate.

1. *Mal-Occlusion of the Teeth.*

The dental arch made by the upper teeth is larger than the dental arch made by the lower teeth. On this account the upper teeth project a little beyond the lower teeth, and the upper incisors overhang the lower ones. With the rest of the teeth each upper tooth fits between or partially over two lower teeth. Unless the cusps of the teeth fit accurately there is a wedge-like action between the two sets. When this is excessive it is capable of producing

marked deformity. This deformity shows in the alveolar process and in the shape of the arch. For a long time it has been known that the normal growth and placing of the molar teeth depends upon the normal growth of the antrum. It has been shown also that the normal growth of the premaxillae depends upon the normal growth of the incisor teeth. The teeth, there-

Fig. 18.

Tracing from a cross section of the head and face showing a V-shaped palate due to low descent of the antra. In this case the nasal fossae are of normal width, they are not narrow as is usually the case when the antra are low and the arch of the palate V-shaped. Tracing seen from behind.

Out of a hundred heads from the dissecting room, only three examples of the V-shaped arch were found. Two of the subjects were white and one was colored.

fore, are responsible more than any one single cause, for the form of the palate. Mal-occlusion is one of the most common deformities of the teeth, and so one of the most important methods of changing the form of the hard palate. (Fig. No. 16.)

2. *Low Descent of the Antra.*

Where the arch of the palate is high and pointed, in a majority of cases the X-Ray shows that the antra descend well below the floor of the nose into the alveolar process. Normally the antrum descends a quarter of an inch below the floor of the nose, but in cases of high arch the floor of the antrum may be one-half inch below the floor of the nose. (Fig. No. 17.) Out of one hundred heads from the dissecting room I have been able to find

Fig. 19.

Tracing from a cross section of the head and face showing marked inequality in the size of the antra. The left antrum is much smaller than the right. The antra do not descend below the floor of the nasal fossae, and their inequality in size has not resulted in any inequality of the two sides of the palate. Tracing seen from behind.

The arch of the palate is flat and wide. This is due to the thickness of the alveolar process not to the excessive width of the nasal fossae.

only three examples of the V-shaped arch. In all of the three specimens the nasal fossae were narrow and the antra descended well below the floor of the nose. In one of these cases, the nasal fossa at its floor was only a quarter of an inch wide. The normal width is nearer a half of an inch. While in extreme cases it may be three quarters of an inch. Where the nasal fossae are narrow

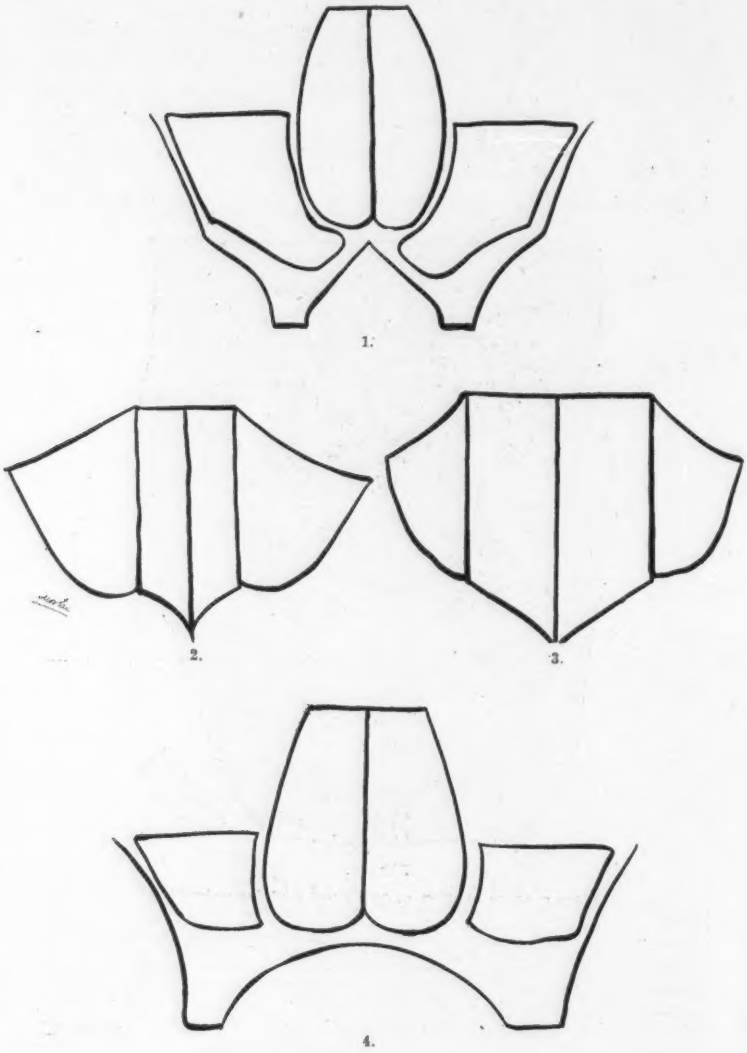


Fig. 20.

1. V-shaped palate, due to narrow nasal fossae and to low descent of the antra.
2. Horizontal section of Fig. 1, showing the narrowness of the nasal fossae.
3. Horizontal section of Fig. 4 showing the width of the nasal fossae.
4. Broad, flat palate, due to wide nasal fossae and to small high antra.

and the antra descend well below the floor of the nose the slope of the inner side of the floor of the antrum gives the slope of the sides of the palatal arch. (See figs. 18, 19.) Numerous examples show that the converse of this is true, that is, where the nasal fossae are wide and the antra are on a level with the floor of the nasal fossae or above them, the arch of the palate is wide and flat. (See fig. No. 20.) The two prominent, if not the two chief factors in determining the height of the palatal arch, are, therefore, the width of the nasal fossae and the degree of the descent of the antra.

3. *Unequal Growth Between the Parts of the Septum.*

I have seen the statement that a marked median ridge of the palate is a characteristic of Peruvian skulls. The impression that it occurs chiefly in early races must be supplemented by the

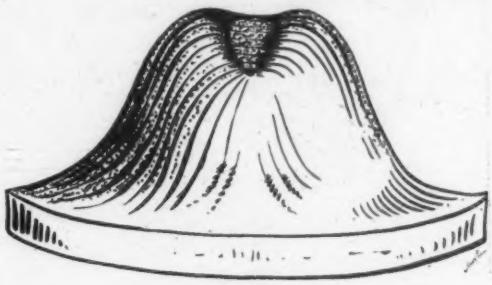


Fig. 21.

Diagrammatic drawing of an impression of a palate with a median ridge.

statement that it is common also at the present day. I have found it frequently in skulls from thirteen years on. Modern dentistry has taught us what slight but continuous pressure will accomplish in changing the form of the alveolar arches. Some such explanation is the best one which I am able to offer for the occurrence of this peculiarity of the palate. At birth the premaxillary wings and the nasal spine are very small. When the second teeth appear the premaxillary wings grow rapidly in order to keep control of the tip of the septum. The nasal spine grows equally rapidly. At birth also there is no crest on the palatal processes of the palate bones and the superior maxillae, but with the growth of the premaxillary wings and the nasal spine the crests of these bones likewise develop and grow upward. If, now, there is a disproportionate growth between the crests of the palate bones

and the superior maxillae and the downward growth of the upper and larger part of the septum, the median line of the palate might be forced down into a median ridge. More than this happens in some animals. (See fig. No. 21, 22.) In certain whales, for instance, the lower edge of the septum makes a free ridge in the center of the palate, the palatal processes not uniting with it. Sometimes instead of a median ridge the whole central part of the palate mounds down in a plateau. I have one example

Fig. 22.

Impression from the palate of a boy of twelve years. There is a marked median ridge in the center of the palate. The side view of this impression is shown in figure No. 11.

of this formation. The X-ray shows that the nasal fossae in this case are excessively wide. Thus it would look as if excessive outward and downward growth of the nasal fossae was responsible in this instance, for the peculiarity of the palate. (See Figs. Nos. 23, 24.) There is another explanation for this median ridge. It can be due to exostoses along the central suture line. Partial ridges due to this cause are common. In one skull which showed elsewhere

very marked arthritic changes I found a large median ridge. How often this median ridge accompanies rheumatism I do not know. It would be interesting to determine if it is common.

4. *Faulty Shrinking and Faulty Readjustment of the Premaxillae.* The arch with projecting premaxillae is characteristic of the negro race. It is an animal peculiarity and gives a very distinctive form to the face. The proper shrinkage and readjustment of the premaxillae play a very important part in the formation of the

Fig. 23.

Wide arch with a plateau like mound in the center. The width of the arch is due to wide nasal fossae, small high antra, and possibly to retention of the canine teeth.

palate. In the evolution of the skull of man from the skull of his animal predecessors there are two great changes, the increase in the size of the cranium in order to accommodate the larger brain, and the disappearance of the snout and the shrinkage of the jaw owing to the lesser importance in man of the sense of smell and the fact that the teeth are no longer used for obtaining food and for defense. The enlargement of the cranium is a much easier mechanical problem than the obliteration of the snout and the

proper readjustment of the parts of the hard palate. In order to realize what must be accomplished before man is reached take, for instance, the hard palate of a bear. (See Fig. No. 25.) In the bear the largest part of the hard palate is made up by the palatal processes of the palate bone. The palatal processes of the superior maxillae make the next largest part, and the premaxillae the smallest. When the palate of the bear is compared with the palate of man, the bones which have changed the most are found to be the palatal processes of the palate bones and the two premaxillae. The

Fig. 24.

Tracing from an X-Ray of a case of wide, flat palate, with a plateau-like mound in the center. The wide arch in this case is due to wide nasal fossae, small high antra and possibly to retention of the canine teeth. See Fig. No. 23.

palate shrinks from before and from behind, the middle changes but little.

In man the premaxillae not only shrunk in size, but they turn downward so that the incisor teeth become nearly vertical. In order to have a normally formed palate, these two changes, shrinkage and downward tilting of the premaxillae must both be accomplished to the proper degree. Often, however, the premaxillae fail to accomplish one or both of them. When both fail

to occur the negro form of palate results. In this case the premaxillae are large and shoot markedly forward. In other respects the arch is very symmetrical. In still other cases the premaxillae remain large, but they change their position properly and bring the incisor teeth nearly to a vertical line, so that there is only the normal overhang. It is a peculiarity of the dentition of man that when the teeth are fully erupted they all reach down to the same level. The anterior teeth reach this level first and the molars last. In

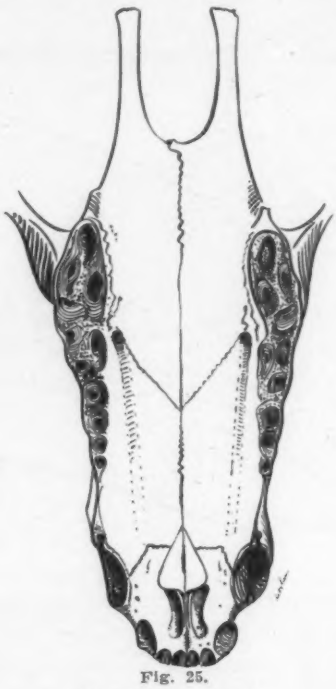


Fig. 25.

The palate of a bear.

other words the anterior teeth give the level which the other teeth must attain. If, now, the premaxillae are longer than they should be owing to lack of proper shrinkage, the palatal arch will be deep anteriorly, and when growth is completed and the rest of the teeth have reached the level set for them by the incisors, the arch will also be deep posteriorly. Non shrinkage of the premaxillae, therefore, is one cause of the high arch. Such an arch is

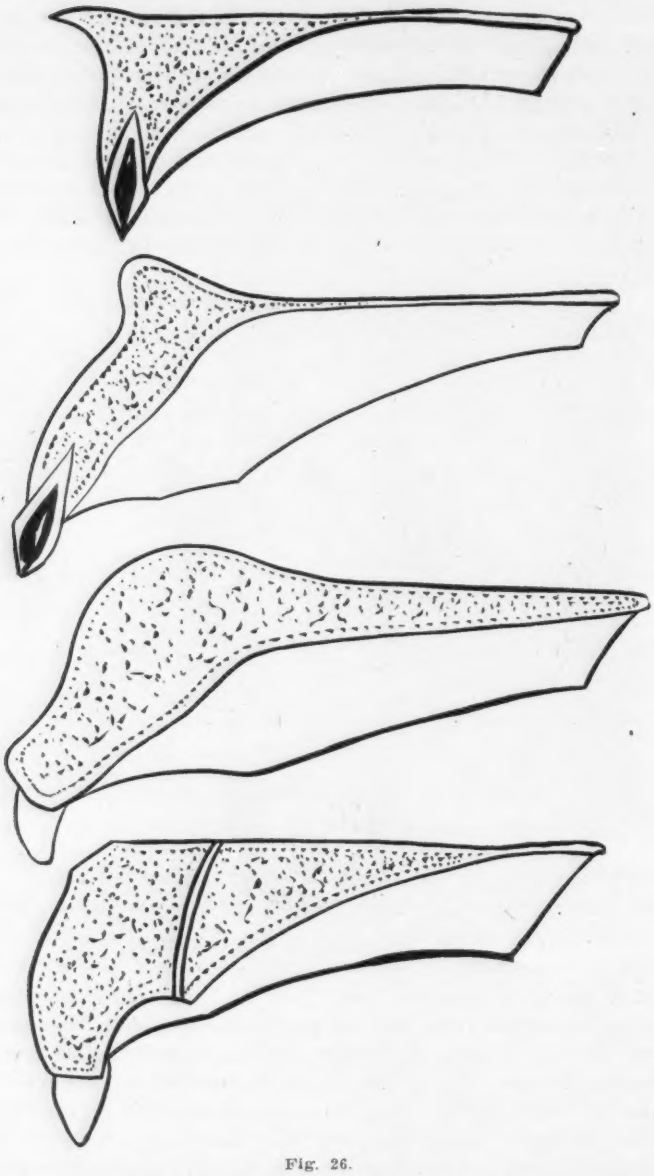


Fig. 26.

The upper figure represents a palate in which there has been normal shrinkage and readjustment of the premaxillae. The other figures are from cases in which these changes have been faulty. (The figures are larger than life size).

not usually pointed, but has a narrow symmetrically curved dome. (See fig. No. 26.)

5 *Asymmetry of the Palate.*

In the clinic asymmetry of the two halves of the palate is seen very frequently. It is found from ten years of age onward, and it can be demonstrated very prettily by impressions of the palate taken in modeling compound and by the X-Ray. (Fig. 5, 6, 7, 27, 28.) On examining carefully a palate where this occurs, one side is seen to be higher than the other. One antrum also usually is higher than the other. I have, however, found the reverse of this. The asymmetry of the two sides of the palate may be a part of asymmetry of the two sides of the head as a whole, or the

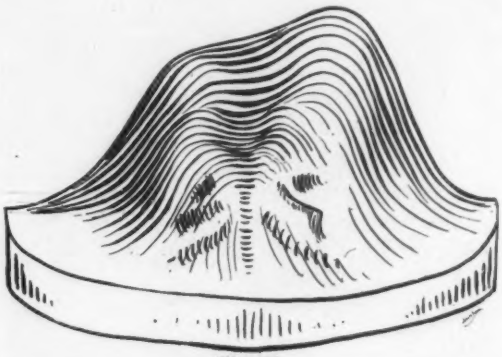


Fig. 27.

Diagrammatic drawing to illustrate asymmetry of the palate. The left side of the palate is higher than the right.

asymmetry may be confined to the face. In the cases of asymmetry of the palate which I have collected, facial asymmetry and asymmetry of the halves of the head have occurred about the same number of times. In one case the inequality of the two sides of the palate was due to asymmetry confined to the superior maxillae, the rest of the face and the head being perfectly symmetrical.

In cases of asymmetry of the palate the impression taken in modelling compound shows that one side is higher than the other, and the X-Ray shows that one nasal notch is higher than the other. If a cast is taken of the brow the superciliary ridge on the high side of the palate is more prominent than the one of the other side. If the asymmetry includes the whole half head the frontal eminence on the side of the higher half of the palate is larger than

that on the other side. When the asymmetry is confined to the halves of the face the frontal eminences are equal but the swelling of the superciliary ridges are not, the ridge on the high side of the palate being the more prominent. Growth in the frontal sinus seems to take place forward instead of upward.

The Effect of Asymmetry On the Dental Arch.

When one-half of the palate is higher than the other the line of the teeth on the side of the palate which is the higher, loses its curves and becomes straight. On the other side the curve of the dental arch is rounded and more nearly normal. (See Fig. No. 6.)

CONCLUSIONS.

The most frequent cause of asymmetry of growth between the two halves of the face I believe to be some fault in the eruption or

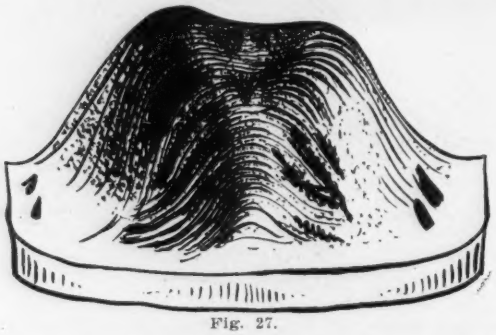


Fig. 27.

Impression showing a plateau-like mounding in the center of the hard palate.

placing of the teeth. In the upper jaw ten milk teeth have to erupt, perform their function and then disappear. They are replaced by sixteen permanent teeth. Twenty-six separate bones therefore, are developed in connection with the upper jaw. There are consequently just twenty-six chances for development to go wrong. It goes wrong so often that a separate speciality has arisen in dentistry to deal with deformities of the teeth due to faulty development.

In a paper published about a year ago I brought up an observation which had long lain dormant. This observation, due to Potiquet, is that faulty descent of the central incisor teeth is associated wth deviation of the septum. On reviewing the

subject, I satisfied myself that this was true and came to the conclusion that the unequal descent of the central incisor teeth and the consequent disturbance of the premaxillary wings was one of the chief causes of deviation of the septum. In that paper I stated that unequal descent of the antra resulting in inequality of the two halves of the palate was another cause of deviation of the septum, and especially that it was a cause of vomer spurs. Continued observations during the last twelve months have convinced

Fig. 28.

Impression from a case of asymmetry of the two halves of the palate. The left half of the palate is higher than the right.

me of the truth of these statements. In other words, whenever there is an inequality between the two halves of the hard palate there will be a vomer spur on the side of the septum corresponding to the low side, and with the spur there is, in the majority of cases, a deviation of the septum towards the high side. The septum attempts to follow down and to attain its full growth. In so doing it slips out of the vomer groove toward the low side and bends outward one leaf of the vomer

and makes a spur. I now would place asymmetry of the two sides of the hard palate due to unequal descent of the antra or to unequal growth of the superior maxillae as of equal importance with faulty eruption of the incisor teeth in causing deviations of the septum.

I believe that we have in faulty eruption of the posterior teeth as well as the anterior, and in their faulty occlusion, the explanation of fully a half of the cases of asymmetry of the hard palate. In a measure this paper is a continuation of my paper of last year. With the results of that article and of this one in mind we have, then, as causes of deviations of the septum, trauma and faulty eruption and occlusion of the teeth. The practical application of both papers is obvious. It is first: To avoid trauma. This we all do instinctively. It is second: To look after the proper eruption and spacing of the teeth. In the past, pardonable vanity and toothache have sent most of us to the dentist. In the future there should be another and a more scientific reason, namely, the attempt to avoid the harmful effect of poorly erupted and placed teeth upon the septum, and upon nasal respiration.

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Atresia of the External Canal. RUDOLF LEIDLER. *Archiv f. Ohrenheilkunde*, May, 1905.

In addition to a review of the literature of the subject, and reports of a number of cases, most of which were associated with chronic middle-ear suppuration, the author describes the methods practiced at Politzer's clinic. The operation is performed as follows: A post-auricular incision is made, and the canal exposed as in the radical operation. The canal is then enlarged with a chisel, and the obstruction removed. When a sufficiently large opening in the bone has been formed, the operation is completed with a plastic similar to the radical operation. YANKAUER.

TRACHEOTOMY.*

BY CHEVALIER JACKSON, M. D., PITTSBURG.

The operation of tracheotomy occupies a most anomalous position. There is no other justifiable life-saving operation whose reign of usefulness has not been extended by modern methods. This is in part due to the introduction of intubation, but there are several classes of cases in which intubation does not meet the indication and there are frequent individual cases where, for some special reason, the cutting operation is easier, safer and more efficient. Yet even here, the profession hesitates longer to advise tracheotomy than it did fifty years ago. The principal reason for this is probably the introduction of general anesthesia, which in this single instance was a distinct step backward. The cough reflex is the watch-dog of the lung, and when the trachea is to be opened should be preserved or stimulated, rather than drugged asleep. Aside from this, general anesthesia has, strange as it may seem, rendered our technic more hasty and careless than previously. When tracheotomy is decided on, there is usually sufficient dyspnoea to demand some voluntary use of the extraordinary muscles of respiration. As complete anesthesia approaches, this voluntary action ceases, cyanosis increases until the respiratory center is paralyzed from over-stimulation, and the patient makes no further breathing effort. He never will make another breathing effort unless the trachea is opened widely and on the instant. For with an obstructed larynx, artificial respiration is never efficient for complete oxygenation of the blood. The trachea under these circumstances is opened by a stab, rather than an incision, and it is small wonder if the percentage of mortality is almost as high as of stab wounds, inflicted with homicidal intent. In the hands of the most skillful and experienced, the incision is usually badly placed; in the hands of the unskilled or the excitable, serious accidents have occurred, such as the opening of the esophagus or a large vessel. A collection of tracheotomy specimens shows incisions at all sorts of positions and angles. One specimen shows a slicing off of the side of the trachea like a slab from a log. There is no time for asepsis or hemostasis; the opening is made at the bottom of a pool of blood, and the first inspiration necessarily pumps clots, and possibly pus,

*Read at the meeting of the Eastern Section of the American Laryngological, Rhinological and Otological Society, January 9th, 1909.

into the bronchioles, where it remains, because the cough reflex is absolutely abolished by the cumulative action of general anesthesia, deep cyanosis, and shock. We have therefore a large mortality from shock, hemorrhage, sepsis, and broncho-pneumonia.

How prone the profession is to under-rate the dangers of general anesthesia is shown by a case of my own. In a child of four, papillomata of the larynx were readily removed after a tracheotomy under infiltration anesthesia and the administration of chloroform, through the tube. Nothing could have been easier, simpler or more satisfactory. Operation for a slight recurrence of the growth became necessary, and general anesthesia was suggested. In the light of the satisfactory previous experience, it is difficult to say why, as a precautionary measure, I called a consultant, choosing a man who prefers the safe side always, who has a strong bias in favor of local anesthesia, and with whom I had frequently discussed this very point. He noted that stridor was not extreme; dyspnoea, as evidenced by action of the extrinsic muscles, moderate; and that there was not the slightest hint of cyanosis. He gave a positive and clean-cut opinion that general anesthesia in this case would not be especially dangerous. Nevertheless, before anesthesia was complete, the child stopped breathing, and the life-saving tracheotomy looked more like assassination than operation.

Our general conception of the operation is a composite picture of many such instances, and we are therefore disposed to defer it until dyspnoea and cyanosis are extreme, or to omit it altogether, if the condition of the patient appears hopeless. These accidents should, however, teach exactly the opposite lesson. For we frequently save life when the patient is in coma, limp, and relaxed, with the respiration entirely abolished, and the pulse nearly or quite imperceptible. In the experience of all of us, many times has the result of quick work seemed like quickening the dead. In one of my own cases the heart, as well as the lungs, had ceased to act, according to Dr. Clarence Ingram and Dr. Thomas T. Kirk. It is hard to understand how a patient's condition can be too bad for operation. Under local anesthesia and at the proper time, tracheotomy should be free from dangers of shock, hemorrhage, or consecutive broncho-pneumonia. Between the skin and the trachea, in the middle line, there is no large vessel, and no important structure. There should be no more mortality from the operation, *per se*, than from the opening of superficial abscesses by an incision of equal length. Wider employment of tracheotomy in the more favorable classes of cases than is now usual, besides reducing its

mortality almost to nil, will give us a better conception of its usefulness. The wonderful general therapeutic effect of better oxygenation and the local improvement from putting the larynx at rest can be seen even in such serious conditions as typhoid perichondritis and laryngeal tuberculosis. Yet it is, I think, unknown to the general practitioner, and under-appreciated by the laryngologist. In giving the statistics of my cases of tracheotomy to date, I do not overlook the fact that the slight mortality is to some extent a matter of good fortune. It is beyond hope that my next one hundred cases will show a similar happy result. But that even as a matter of fortune such a series of cases is possible, shows that the operation is much less dangerous than is generally supposed. It is to be noted that in the majority of cases the technic was deficient in some or many important points, and if the series had shown even a ten or fifteen percent mortality, it would not have changed my opinion that the operation is an entirely safe one when performed with the care and precision that modern surgery demands in every other locality, and done at the first indication, not after carbonic poisoning has made recovery impossible.

Technic.

The different points necessary to put our technic on a plane with the other departments of modern surgery may be arranged as follows, in my opinion, in the order of their importance:

First.—Preservation of cough reflex by the omission of chloroform, ether, morphine, codein and other sedatives, and the avoidance of marked cyanosis by early operation. I have a standing order in all the hospitals where I work that under no circumstances is any sedative to be given in any laryngeal or tracheal case.

Second.—Deliberate work, careful dissection exactly in the middle line until the wind-pipe is laid bare, and absolute hemostasis before it is opened are desirable. When the operation is done as a matter of election at an early period, and without extreme cyanosis, there is no reason why we should not wait until the wound is not only dry, but glazed, before the wind-pipe is opened.

Third.—Careful after-treatment—good ventilation, uniform temperature, moist atmosphere, frequent dressings of the wound, preservation of the patient's vitality by all temporary and permanent means—reduces mortality. To trust to routine surgical hospital nursing is to court disaster. It is imperative that the case shall be in the care of a nurse trained in tracheal work. She must know by the sound when the canula is even slightly obstructed, and

must distinguish between this sound and the usual stridor serraticus. No one can describe this or any other sound so that another may know it. It must be heard many times to educate the ear to niceties of distinction. The nurse must be trained to dress the wound, for the dressing must be done very frequently, even every half-hour, if secretions are abundant. The old surgical rule to disturb the wound by dressing as seldom as possible, is one of the causes of the high mortality of tracheotomy under routine surgical regime. Conditions here are entirely different from anywhere else in the body. The secretions and discharges must be absorbed and removed by very frequent dressings. Gauze wrung out of mercuric chloride, 1 : 10,000, is used in three pieces.

a. To pack around the canula.

b. A bibb piece on the surface surrounding the stem of the canula under the tape-holders.

c. A filter piece to lay over the entire front of the neck.

This latter piece should be changed as often as soiled, even if every ten minutes. Both the filter and bibb pieces should be fastened by small safety pins at the side of the neck to the tapes which hold the canula. Thus no bandage is needed.

The inner canula should be cleaned by the nurse as often as necessary, boiling it after cleaning it with a pistol-cleaning bristle brush bent to shape. The outer canula is to be removed only by the surgeon or his assistant, though the nurse must know how to find and dilate the tracheal incision in the depths of the wound, should the canula accidentally be withdrawn or be coughed out, owing to the breaking of the tapes.

Fourth.—Asepsis. The technic of the operation and of the dressings should be as nearly perfect asepsis as it is possible to be. The tracheal secretions will unavoidably infect our wound, but we must not add any infection. The patient is usually immune against the organisms he himself harbors.

Fifth.—Trendelenburg-Roser position at the moment the trachea is opened is an advantage. The tracheal mucous membrane will bleed slightly, and with a diseased larynx infected secretions may be aspirated in at the first deep inspiration. We should aid cough all we can by the influence of gravity. None of these points is hard to secure except the avoidance of general anesthesia. As the virtues of the infiltration method of Schleich become more familiar to us, this will be easier than general anesthesia and a great time-saver, requiring but a minute. Infiltration of the skin is easy

and renders the first incision absolutely painless. The deeper tissues are not so easy to infiltrate. Brown-Sequard's statement that the first incision, when made exactly in the middle line, anesthetizes the deeper tissues, is erroneous. But the sensation in the underlying parts is slight. The incision may be carried through them, even in a child, with less distress and struggle than is involved in the administration of a general anesthetic.

Sixth.—The canula must be of proper size and length. Nearly all the canulae in the shops are worthless, being both too short and of too short radius. Most of them will not reach the trachea after the neck has swelled in the reaction. I have been unable to find in stock a canula which could be with safety trusted to leave in the wound over night. I know personally of three cases seen in consultation where death, said to be due to gradually increasing stenosis, was really due to the shortness of the canula, which was withdrawn by the swelling until the inner end slipped out of the trachea. Air still passed in and out through the approximated lips of the incision, but in insufficient quantity, and it became less and less. The carbonic acid narcosis, together with the residue of the chloroform narcosis, and the weak toxemic conditions (due to febrile disease) of the patients, with the assistance of anodynes,—these things enable the patients to sleep away. The death was ascribed to increasing stenosis, and in one instance to this combined with edema of the lungs. In some cases the stenosis in the trachea was not reached by the canula when first inserted, and the diagnosis was "edema of the lungs" or "intra-thoracic conditions too deep to reach." In such instances the long tracheal canulae devised by me to reach to the bifurcation of the trachea are needed.*

In one patient recurrence of endothelioma, following laryngectomy, had extended down the trachea until but a fistulous tract leading to a stump of the two main bronchi remained. The patient has been thus kept alive for four months, and an ample passage for air can and will be maintained until the patient succumbs to exhaustion, hemorrhage, or some of the other termini of such cases. He will not die for want of an air passage to his bronchi.

In regard to the execution of the operation in the urgent cases, two incisions are better than one. The first should penetrate to the trachea, which is then felt like a wash-board under the left forefinger. This finger acts as a guide for the second incision which should follow the first in a second's time. With the wound a well of blood, there is little need for a light until the vessels are to be

*Journal American Med. Assn., May 25th, 1907.

caught up, which should not be attempted until the respiration has been started and the patient is able to do his own breathing.

In looking over the statistics of my cases I find it impossible to accurately figure out the percentage of mortality. Two patients whose larynx was removed died (two deaths in eleven laryngectomies) within ten days of the operation. Neither died of lung complication, and in any event it would be, and is, impossible to say that the tracheotomy could not have been a factor, but in these and other cases where major operations followed the tracheotomy, it is much more reasonable to suppose that it was the major operation.

Of the one hundred tracheotomies done up to the time this paper is being prepared, eighty-six patients are now living, or were so when discharged from further treatment. In ten other cases death resulted from the conditions that required tracheotomy, or from the major operation which followed the tracheotomy. In one case it is impossible to deny that the tracheal incision may have had a fractional share in inducing the shock that finally caused death thirty hours later, and in three cases death was certainly due to tracheotomy. The author is aware of the fallacies arising from an analysis of his own statistics; but an analysis is necessary for the reasons given. He can only give the opinion of others concerned in the cases that in the ten fatal cases alluded to, the tracheotomy could not have acted even as a predisposing cause, and there seemed to all of us no doubt that in all of them it prolonged life by prevention of cyanosis and facilitation of other necessary and more serious operative interference.

No claim is made for priority in the advocacy of local anesthesia for tracheotomy, for Theisen, Root, and many others have urged it; but the statistics of hospitals all over the United States show that it is almost never used. From a complex solution the author has come to use a solution of one grain of cocaine hydrochlorate and one drop of carbolic acid to the ounce of sterile water, allowing the solution to stand long enough for chemical sterilization to take place. To boil a cocaine solution is to destroy its anesthetic powers. Intradermatic, not hypodermatic, injection is the procedure, the needle following the blanched track it makes ahead of itself.

Westinghouse Building.

LARYNGECTOMY. SPECIMEN. METHOD OF ARTIFICIAL VOICE PRODUCTION.*

BY J. W. GLEITSMANN, M. D., NEW YORK.

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Corresponding Member of the Vienna and Berlin Laryngological Societies.

The larynx which I hand you for examination was removed from a patient, male, 60 years of age, December 29, 1908. The operation was performed after the method of Gluck, viz., the trachea was sewed to the skin. I had the valuable assistance of Dr. Kiliani at the operation as well as during the after treatment, which proved to be an assurance as to the proper execution of the operation, when the fatal issue came.

It has been frequently stated that such operations ought to be reported, if successful or unsuccessful, as only in this way can reliable statistics be obtained. Aside from this desideratum, the case presents some additional interesting features, which I shall briefly mention.

(1) The previous diagnosis before I saw the patient, as to the nature of the ailment, which, if based on some clinical observations, was certainly overshadowed by the true lesion.

(2) The small size of the growth after extirpation and opening of the larynx, when we are accustomed to see generally in the specimen a larger tumor than by the inspection with the laryngoscope.

(3) The manifold steps to relieve the patient, who had an unusual fortitude of character, and showed unbounded confidence.

I shall condense the history as much as possible, and give only the salient points.

Early in the summer of 1908 one of our most competent colleagues had seen the patient and detected a small growth in his larynx, the nature of which he could not positively determine. Instead of returning to him after a month, as he was told to do, he went to a southern health resort, as far as I could learn, on the advice of a physician, who had previously treated his throat ailment. The southern physician thought to find symptoms of tuberculosis, in which belief he felt justified by slight exacerbations of temperature and a moderate reaction after tuberculin injections. But the laryngeal condition after several months became so aggravated that he recommended him to call on me for relief.

*Read before the Section on Laryngology and Rhinology of the New York Academy of Medicine, January 27th, 1909.

I saw him for the first time on October 13th, 1908, and found the left half of his larynx filled with an irregular and apparently soft growth extending down to the glottis, and a circumscribed, pea-sized growth above the right ventricular band. The tumor did not impress me as being of a tubercular nature, and I also never found at that time, nor later, any symptoms of tuberculosis. As I could not commit myself to a positive diagnosis, I told the patient that excision of some specimens was necessary for microscopic diagnosis, but impressed upon him at once that he would have to consent to a major operation, if malignancy was found.

He returned next day, several pieces were excised, those of each side put in different bottles, and the patient went home the next day. The microscopist's report was that cancer existed on the left side, whilst at the right side only pachydermia was found.

This statement of a unilateral involvement made me believe that I was justified in removing the growth by laryngotomy, which was done one week after his first visit, and in which the left side was radically exenterated and the major part of the right ventricular band also removed. He recovered from the operation without untoward sequelae, and left home after a few weeks, no tumefaction being visible, but some mucopurulent secretion persisted. The tracheal and laryngeal wound had completely healed.

As far as I know, he had no active treatment while at home, but after ten days he wrote me that he was restless at night and not breathing as well as when he had left. When he returned I was greatly shocked to find the same encroachment on the larynx as at his first visit, but the growth was now mainly confined to the right half, and formed an irregular mass with peg-like protuberances. Immediate relief was necessary, and I removed at once eleven or twelve pieces endolaryngeally, chiefly from the right side, one from the anterior commissure and one from the posterior wall. The reaction after this operation was considerable, which did not give the patient the free breathing space which otherwise the removal of the growths had permitted. This condition gradually subsided under local treatment, and twelve days later the patient said that he had not been feeling nor breathing as well for six months past.

The microscopic examination showed unmistakable cancer, but the patient felt well, ate well and gained in weight. It was therefore deemed best to defer laryngectomy, to which his consent had been obtained, as long as he was improving, or till the growth would recur, which was observed three weeks later.

The operation was made in the usual manner, the trachea opened and sewed to the skin, the larynx liberated from the oesophagus and the surrounding parts and excised. There was no difficulty in uniting the pharyngeal mucosa.

For several days the patient progressed very favorably and swallowed small quantities of milk on the fourth day. On the fifth day—the skin having united—a pocket was found under the skin above the tracheal opening leading upwards on the right side of the throat, but till evening of the seventh day, aside from the above focus of infection, his chances for recovery were in his favor. During the night he had a violent coughing spell, after which he became somnolent and could not be roused any more, and he died next day at 11:30 a. m.

No autopsy having been made, the immediate cause of his death is most probably a pneumonic process, possibly embolism.

It was my intention later on to teach the patient exercises, devised for and apt to produce the so-called pseudo-voice, which quite a number of patients have acquired after laryngectomy, either spontaneously or after proper instructions.

The ability to speak in cases of occlusion of the larynx in consequence of morbid processes or of suicidal attempts has been known for several decades. The first case of voice production after laryngectomy was reported by the late H. Schmid[1], of Stettin, 1888, and the patient was demonstrated by J. Wolf,[2] 1893, before the Berlin Laryngological Society, on which occasion B. Fraenkel gave an explanation of the process. The second case is the well-known patient Hickey, operated upon by S. Solis Cohen,[3] April 1st, 1892, and shown in October, 1893, to the Philadelphia Medical Society. The patient's voice was distinct and loud enough to be heard across a large hall; he allowed himself to be shown in many cities and societies, and one of our confreres took him (1895) to England for demonstration at the British Laryngological Association. The two patients of Schmid and Cohen learned to speak spontaneously without any medical advice or training.

The two cases reported by Gottstein,[4 5] of Breslau, received instructions, based in the first one on an observation made by the patient himself, the second one by methodical instructions, derived from the former experience. His first patient learned to pronounce vowels spontaneously, when he bent his head down till his chin rested on his chest. Advised by Gottstein to continue his efforts after he had left for his home, and to endeavor to produce a

sound when raising his head, he could, when seen four months later, pronounce all the vowels in a natural position, and one year after the operation was able to produce different tones and sing a simple song. By utilizing the observations made in this patient, Gottstein succeeded in teaching the second one an audible voice within six and a half weeks after the operation.

In an elaborate paper on Voice and Speech without Larynx, read before the Vienna International Laryngological Congress of 1908, Dr. H. Gutzmann,[6] of Berlin, speaks at length about the history, the different modifications, the necessary anatomical requisites and the method to be pursued for artificial voice production. The opportunity of giving instructions to patients operated upon by Th. Gluck gave him a large experience in this line.

The first requirement for tone production is the creation of an artificial receptacle of air, an air-chamber, as the pulmonary air can no longer perform this function. The majority of patients succeed in producing this air-chamber by pumping air into the hypopharynx by repeated swallowing, which Gottstein's patient was able to do thirty times in succession. In this manner, in patients learning to speak, an air-chamber is created in the hypopharynx, which chamber is located below a space which can be narrowed by will power, and which is capable of vibrations and tone production by the voluntarily emitted current of air from below.

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The Medullary Nerve Fibres in Cases of Nasal Reflex Neuroses. V. Widakowich. *Monatsschrift f. Ohrenheilkunde*, Aug., 1905.

In a disputation over this subject, the author claims that he has investigated the question of the number of nerve fibres in the nasal mucous membrane of patients suffering from nasal reflexes, and finds that they are no more numerous than in the normal nasal mucous membrane. Yankauer.

ASTHMA FOLLOWING OPERATIVE MEASURES IN ETHMOIDITIS.*

BY DUNCAN MAC PHERSON, M. D., NEW YORK.

The relationship existing between internasal abnormalities and asthma has been so comprehensively dealt with that the recording of new data of value springing from my own observation is not intended to be the subject of this short paper, the object being, rather, to emphasize the fact that asthma can and does result from operations upon the ethmoidal sinuses.

Bearing in mind the hyperesthetic theory of nasal asthma, one is surprised that more cases are not recorded and that this complication does not follow more frequently than seems to be the general experience. Many cases are recorded of the cure of asthma by surgical attention to hyperesthetic areas in the nasal chambers, but a fairly complete investigation of the literature published in the English language covering the period of the last ten years, during which time operations upon the ethmoidal sinuses have been more popular, failed to bring to light much proof that the converse is true, i. e., that asthma may be induced by the artificial production of hyperesthetic areas in the nose, and furnished no evidence at all that it could be produced by surgical operations upon the ethmoids. It is therefore presumed that this cause and effect do not often go together and that my own experience of having seen three cases in almost as many years is unusual and must be my excuse for using a few minutes of the valuable time of the Section.

It is not contended that in the three cases to be reported, the asthmatic attacks resulted from the ethmoidal operations alone, but it is believed that in all three cases the attacks were precipitated by the operations. In one, no primary cause was discovered. In another bronchitis was present and may have had an influence toward producing the attack, while in the third a thorough examination was not possible. None were previously afflicted with asthma, and in all the attacks came on in from two to three weeks subsequent to the operation. In all three the attacks were unusually resistent to drug, dietetic and other remedies, and in one case to climatic treatment as well. In what may be termed idiopathic asthma, drugs and other well known therapeutic measures do have for a time at least some effect.

*Read before the Section on Laryngology and Rhinology of the New York Academy of Medicine, January 27, 1909.

The first case, a man, came under my observation and treatment several years ago, in the clinic of Drs. Knight and Wright, at the old Manhattan Hospital, but as I was then more busily engaged with general practice than with this special department of medicine, and not expecting that the case would develop into one of particular interest, no notes were made that enable me to locate the patient or his clinical history. This case responded to no drugs, the opiates excepted, and when codeine no longer gave him much freedom from the paroxysms his attendance at the clinic ceased before other measures could be instituted. This case was gone over thoroughly in efforts to find a cause for his asthma rather than to exclude all other causes than the operation, inasmuch as I did not then regard the ethmoidal operation as being so closely related to the trouble. No other cause was found.

The second case being a private one, the history is fortunately more complete and is as follows:

Mrs. M., married, aet. 30, came to me in June, 1907, stating that she had been troubled with a dry cough off and on for two months, and sneezing a great deal for a year. During no season did she suffer more from the sneezing than at any other. She used about six handkerchiefs daily, the discharge being at times thick, at other times thin; had some difficulty breathing through her nose, was susceptible to head colds, and was not as energetic as formerly. There was no loss of weight, her appetite was good and bowels regular. Had been using different cough syrups, but her digestion was not disturbed. On physical examination, slight rales were heard throughout the chest. An ecchondrosis of the nasal septum, and a discharge believed to be coming from the ethmoids, were found. The uvula was elongated. Under creosote the cough gradually became less, and later the ecchondrosis and a piece of the middle turbinate were removed, and a week or so later the ethmoids were curetted and some small polypi uncovered and removed. The patient made the usual progress for about two weeks, when her visits ceased. About three weeks later I was consulted again and was told that, her cough getting so much worse, she had consulted her physician, who made a diagnosis of capillary bronchitis, that she coughed so much at night even when taking codeine and heroin that neither she nor other members of the family were able to sleep. She was compelled to sit up all night. Her cough during the day was also very severe. An examination and the history led to a diagnosis of asthma, and Dr. A. A. Smith was called in consultation. No cause other than the nasal condition was found to account for

her trouble. No relief being obtained by any treatment instituted apart from increasing doses of opiates and cocaine applied locally, and these only giving partial relief, it was decided to try the influence of climate. She went to different parts of Canada, including Muskoka, which is supposed to be an antiasthmatic region, but getting no appreciable relief she came to the Adirondacks, where she was unable to remain, owing to the still greater severity of her trouble. She arrived in New York very much discouraged and refused to seek further relief by climate. For weeks oxygen had to be resorted to for relief, at night, especially, but recently, while she coughs persistently, the spasms are not so violent. Incidentally, during her travels seeking for relief, different rhinologists were consulted, but no interference of any kind was deemed necessary, showing that the condition was not due to spicules of bone, rough surfaces or any of the usual conditions supposed to produce nasal asthma. Apart from a sensation of the fullness that often follows an operation of this kind, no subjective nasal symptoms were present. This patient's temperament was not neurotic although some shock probably accompanied the operation. Moreover, the attack did not come on for several weeks after the operation and probably resulted when the protective scales fell off, thus leaving the delicate nerve terminals exposed. In this case, on account of the bronchitis and nasal occlusion, it may be said that asthma would have made its appearance anyway. This I believe to be true, but the fact that asthma made its appearance after the bronchitis was relieved and the nasal obstructions removed would point to the exposure of the ethmoids as being the immediate cause.

The third case, E. M., aged 24 years, came to the Manhattan Hospital on April 18th, 1907, and left May 14th, 1907. When admitted, he suffered from undoubted frontal and ethmoidal disease. He left while still under treatment and while gradually, if slowly, improving. In September, 1908, he came to the clinic of Dr. Harmon Smith, suffering from asthma which he said succeeded an operation performed at another hospital during the latter part of May, 1908. Examination showed that an operation had been performed on the ethmoidal sinuses.

The asthma responded to no treatment that was administered between the time of his first attack, a few weeks succeeding the operation, and the time when he was seen in September at Dr. Smith's clinic, which latter he attended but once, These cases are interesting inasmuch as they would seem to show that asthma may be artificially induced by producing an abnormal condition in the

nose, contrary to the apparent belief of eminent authorities on internal medicine, such as Flint, Loomis and Fothergill, who do not even mention pathological conditions in the nasal chambers as being productive of asthma. It also seems to refute the contention of others, rhinologists, who claim that nasal obstruction is necessary to the production of asthma of nasal origin. Bosworth states that a large majority if not all of his recorded cases of asthma were due to nasal obstruction. Incidentally it may be mentioned that in twenty-five successive cases of ethmoiditis, quoted by Rice, no asthma was present, and in one hundred and fifty cases of asthma recorded by Bosworth, ethmoiditis was not present except when accompanied by polypi. Rice further states that in ethmoiditis the mucous membranes are less sensitive than normal, except where polypi are present, thus rendering the subject perhaps less susceptible to asthma.

On the other hand these cases tend to bolster up the theory that nasal asthma is due to hyperesthesia of the fifth nerve, although they do not strengthen the contention of Frances, who claims that all asthma may be relieved by cauterizing the septal mucous membrane even where polypi are present and left untouched; nor the belief of Fink, who cures his cases by operation upon the anterior end of the inferior turbinate.

In conclusion, while it is not expected or desired that fewer ethmoid operations will be performed, it being presupposed that none are now being done that should not be done in the judgment of the operator, it might be suggested that, in view of the prolonged discomfort, as manifested by pain, sensation of pressure, fullness and asthma, that sometimes follows these operations, an antiseptic, perhaps slightly anesthetic powder or emulsion, might be applied to the newly exposed sensitive surfaces until such time as they adapt themselves by anatomical change to the requirements of their new functions.

No. 467 Manhattan Avenue.

FOREIGN BODY (TOY INCANDESCENT LAMP) IN LEFT BRONCHUS.*

BY JOSEPH C. BECK, M. D., CHICAGO.

Patient, Joe C., 3½ years old. While he was playing with his sister she put something into his mouth, whereupon he became frightened. He began to cry and cough. The mother at once called a neighboring physician, who attempted to remove the foreign body with his fingers, but failing, he called in two other doctors who endeavored to remove the object by means of forceps, likewise without success. The child was then removed to the hospital as quickly as possible, and I saw it late in the evening of the same day. The patient was in good condition. The mother could not tell me what the child had inhaled or swallowed, but thought that it was the metal cap of her umbrella. The little sister refused to say what she had put into her brother's mouth, and the patient persistently pointed to the gas tip. I decided that a radiogram be taken. The fluoroscope showed the foreign body as located in the left side of the chest, between the sixth and seventh ribs, close to the sternum. Dr. Potter took the radiogram (figure 1) with the patient lying face downward, and this shows an oblong body, about an inch long, in the region above described. I decided that it was the metal cap of the umbrella.

Under general anesthetic (chloroform) and by means of Jackson's speculum I found a slightly traumatized epilarynx. I introduced a small bronchoscope (Jackson's), and looked in the left bronchus for the foreign body. There was not much congestion nor mucus present (employed 1-300 atropin previous to the operation). Suddenly the light became covered with some mucus and burned out. Replacing with another and reintroducing, there again was some trouble with the light, so that I could not see well at all. I then used Kierstein's mirror, which was not much better, and I was forced to give it up. I had not encountered any foreign body and concluded that it might possibly be in the esophagus, which I examined with the aid of Kierstein's lamp, but found nothing. The child was placed in bed for the night, having decided to wait until the next morning and then again use the fluoroscope to determine whether the object had passed or was still present. The patient had a temperature of 101° next morning, but appeared to be in good condition.

*Presented at the meeting of the Chicago Laryngological and Otological Society held on October 13th, 1908.

The fluoroscopic examination revealed the foreign body in the same position. Through the kindness of Mr. V. Mueller, who loaned and operated the new apparatus of Bruenning, I was enabled to do better work during the second attempt. I found a great deal of edema of the glottis, so decided to do a tracheotomy and

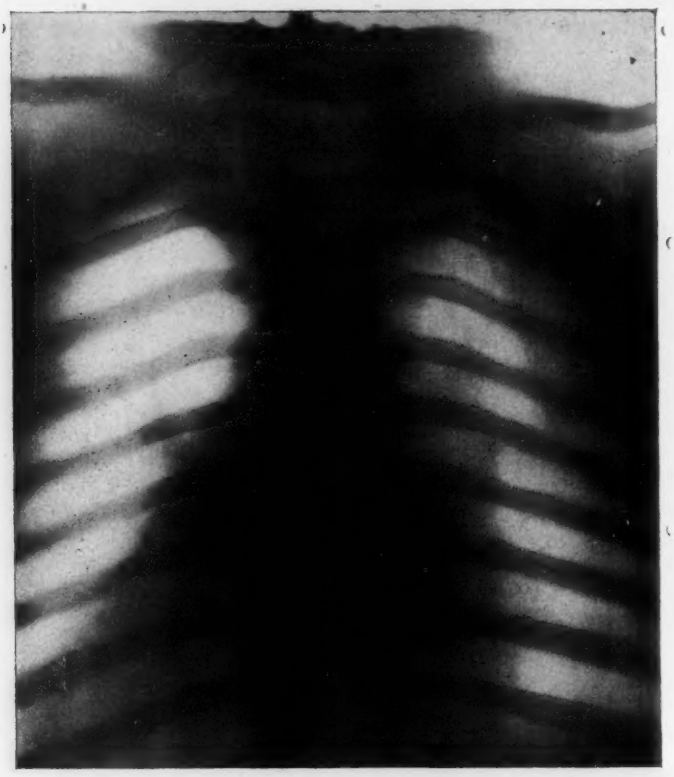

Figure 1.

work through the opening. The introduction of the above mentioned instrument was very easy and illuminated the field very thoroughly. However, I did not find the foreign body where it should be located according to the radiograph, i. e., as low as the sixth rib. Slowly withdrawing the tube, I came upon some projection, and by means of a blunt-pointed probe began to investigate it. It appeared to be hard, and I thought of a cartilage ring. The

child was awakening and began to cough. A considerable quantity of mucus was expelled, and at the same time we heard a clicking sound, something having dropped on the floor. The assistant, holding the patient's head, declared something hard had struck him on the wrist and showed me a blood-stain where the object had struck him. Removing the tube and introducing a tracheal cannula, we then looked about on the floor and there found the foreign body, which was a toy automobile lamp (figure 2). The father, who was waiting for the returns, stated that his children had such

Figure 2.

a plaything, and subsequently the little girl acknowledged having placed the lamp in her brother's mouth. The child made an uneventful recovery, and I herewith present him in evidence.

I had another radiogram taken the next morning, because of a discussion which came up, to the effect that glass does not show in and this is explained by the fact that these small bulbs contain a radiograms. It is interesting to note that this glass bulb did show,

I wish to express my kind appreciation to Drs. Jackson and Eisenstead, and the other gentlemen assisting me in this case.

No. 1220 North Clark Street.

Esophagoscopy for the Diagnosis and Removal of Foreign Bodies.

H. NEUMAYER. *Monatsschrift f. Ohrenheilkunde*, July, 1905.

The author reports in detail twenty-four cases of foreign body in the esophagus. In twenty-one of these cases the foreign body was found by means of the esophagoscope, and its removal was successful in nineteen cases. In the three cases in which the foreign body was not found it had passed into the stomach; it was vomited in one case and passed per rectum in the other two. In the two cases in which the foreign body was found, but could not be removed through the esophagoscope on account of the swelling of the walls of the esophagus, pharyngotomy was done, but both died, one of sepsis, the other of secondary hemorrhage.

In seventeen cases (adults) the manipulation was performed under cocaine anesthesia. In one adult and in six children general anesthesia was employed. YANKAUER.

SOCIETY PROCEEDINGS.

NEW YORK ACADEMY OF MEDICINE.

SECTION ON LARYNGOLOGY AND RHINOLOGY.

Regular Meeting, January 27th, 1909.

HARMON SMITH, M. D., in the chair.

PRESENTATION OF PATIENTS.

Laryngectomy for Carcinoma. Specimen. Method of Artificial Voice Production. By J. W. GLEITSMANN, M. D.

(*Published in full in this issue of* THE LARYNGOSCOPE.)

DISCUSSION.

DR. EMIL MAYER said that the members were much indebted to Dr. Gleitsmann for presenting a case that terminated fatally, for such cases present the lessons that all must take to heart. In this connection he would like to record a case that was in the surgical wards of Mount Sinai Hospital a few weeks since. A man 58 years of age gave a history of hoarseness and some difficulty in deglutition, and a good deal of increasing dyspnoea. A growth involved the right arytenoid and filled the larynx. This was as much as could be ascertained at the time. It was distinctly stated that the cause of the condition was due to the neoplasm. Whether it began as a laryngeal growth and extended posteriorly, it was difficult to say.

Immediate operation was considered advisable, and the growth was easily exposed, showing that it sprang from the oesophagus. It was very large, and grew over into and occluded the larynx. The patient died on the table. The cause of death Dr. Mayer did not know. The patient was a very vigorous man.

A case with a much happier ending was shown to the Section some time ago by Dr. A. V. Moschowitz, in which there was a complete extirpation of the larynx, followed by the suturing of the trachea to the skin. The operation lasted two and a half hours,

and was done under local anesthesia. The patient is still living, two years having elapsed, and is not at all uncomfortable.

DR. DOUGLASS said that this type of cases seems to be peculiarly fatal, unfortunately, for many are led to do the work hoping for good results. It is not quite clear why the fatality is so large; that question has yet to be solved. Traction to the pneumogastric, injury to the pharynx, does not explain it. In the last three to five years he has performed six or seven complete laryngectomies—always for carcinoma—sometimes with the removal of the entire tongue, sometimes only the larynx. All of them ended fatally, even when the operation was quickly done—fifteen minutes for the complete removal of the larynx, and twenty-eight to thirty minutes for the removal of the tongue—and the anesthetic very carefully and sparingly administered. Some of them died from shock following the operation, certainly not from hemorrhage, for that is of very little moment in such cases. One died within an hour after leaving the table; another, on the third day; another, on the fifth, and another on the seventh; and in none of them was the cause of death ascertainable. Certainly it was not pneumonia.

He had been thinking a good deal during the winter of the cause of death in such cases as do not die of pneumonia after laryngectomy, but has not been able to reach any solution. Some day, someone, somewhere, will develop the necessary facility and skill, and the cases will ordinarily get well. He hoped he would be one of this company. Gluck, of Berlin, has published some very good results, and is to-day the most eminent and successful operator in this class of cases.

DR. COFFIN said that he had never undertaken any of these cases, and it would be some time before he did. Two or three have been operated for him, and all have died; but there is a man in this country, a modest gentleman in Pittsburg, who has done most excellent work, who has, if Dr. Coffin is correctly informed, operated on fourteen cases for complete removal of the larynx, without a death.

DR. QUINLAN said that in these cases of laryngeal and tracheal disturbance resulting from carcinoma it is unwise to keep the patients in the recumbent position in bed. In the past two years he has seen three cases where thyrotomy for malignant disease was performed and hypodermic injections of adrenalin and carbolic acid in the growth were followed by marked diminution of the mass. The cases are still under observation. In one the adenopathy has decreased and there is no spread of the disease. In another, there

is apparently a tendency to degeneration instead of the ordinary progression of the disease.

In all of his cases of this kind for the past five years he has set the patients up in bed and kept them in this position as much as possible, and the absence of the pneumonia which generally and almost invariably follows these cases is amazing. Position and the personal attention of the operator has a great deal to do with success; the future will enable us to treat them with more precision and accuracy and to clear up any points that are now obscure. He wished especially, however, to emphasize the value of the upright position. Keep the head above the heart in all head cases, and do it as soon after the operation as possible. Elevate the head as high as possible and as soon as possible, and keep the patient almost in sitting posture. That is the most important point in the treatment of all patients requiring operations on the head or neck.

DR. SMITH said that Dr. Brewer had performed, to his knowledge, at least four successful laryngectomies. In the last three cases he had inserted a tube into the stomach before they were free from the ether, and had kept them in the upright position. He had seen the last case the day after the operation, and found him cheerful and bright, in marked contrast to those that were kept in the recumbent position.

DR. J. W. GLEITSMANN said that, as due recognition had been given to the American operators in the discussion, he would confine himself to recent reports of foreign surgeons. It is well known that in England, Butlin and Semon deserve full credit in stating the indications and perfecting the operation of thyrotomy, which formed the basis of their success. In a quite recent paper, kindly sent by Mr. Butlin to the speaker, he gives statistics of all his operations on the larynx for cancer, including thyrotomy, infra-hyoid laryngotomy, unilateral and total laryngectomy, dividing the thirty-seven patients into two groups. Of nine patients operated upon before 1890, two were well after three years; of twenty-eight patients operated upon after 1890, thirteen were well after three years.

The largest number of major operations in this field known to the speaker were published by Professor Gluck, of Berlin, in the Transactions of the Vienna Laryngological Congress, 1908. He says that one hundred and twenty-eight cases of total laryngectomy, operated upon by himself and amongst them some of the most complicated and extended nature, were cured, and he has not lost a case of an uncomplicated laryngectomy for many years. In a total of about three hundred cases, involving resection of vessels, pharynx,

tongue and part of the oesophagus, he has had a mortality of only thirteen percent.

Dr. Delavan, in a series of excellent papers before the American Laryngological Association on this subject, has amongst other points referred to the immediate and remote dangers and sequelae of total laryngectomies. When surviving the operation, the loss of voice, and the consequences resulting from it, have driven more than one patient to commit suicide.

Dr. Gleitsmann regretted that the discussion did not extend to the feasibility of teaching at least a part of the patients to learn to speak, and believed that with further improvements in this method we shall be able in some cases to obviate one of the most unpleasant consequences of total laryngectomies.

Fibroma of Naso-Pharynx, Apparently Inoperable, Treated by Injections. Presented by Dr. COFFIN for S. MCCULLAGH, M.D.

The patient, aged 19, first came to the hospital two years ago suffering from nasal stenosis. He had been operated upon twice, for posterior tip the first time, and for adenoids the second time. At the time of the first examination the growth looked like a large posterior tip, but it was impossible to engage it in a snare through the nose, even with the finger in the naso-pharynx. After repeated injections with monochloracetic acid, through Dr. Coffin's syringe, such a reduction occurred that a snare was slipped over the growth and it was removed. This was followed by a very severe and dangerous hemorrhage, which was finally controlled by packing. The specimen was lost in the excitement attendant upon the hemorrhage, and no pathological examination was made. Relief was experienced for three months. The patient returned about four months ago with complete occlusion of the left posterior nares. No posterior syringe being obtainable, treatment has been carried out through the anterior nares. This has consisted of injections of one to three minims of monochloracetic about twice a week. The growth has shrunken under this treatment until it is now possible for him to blow air through the affected side.

DR. SMITH said that in 1905 he had presented before the Section a case in which thirteen injections of monochloracetic acid had been made. Since then he had seen the case three or four times a year, and there has been no recurrence. The injections were made with Dr. Coffin's syringe, but no improvement took place until five minims were injected at each sitting. He thought that three minims was too small an amount to produce the proper result.

PRESENTATION OF PAPERS.

Asthma Following Operative Measures in Ethmoiditis. By DUNCAN MACPHERSON, M. D.

(*Published in full in this issue of* THE LARYNGOSCOPE.)

DISCUSSION.

DR. CARTER congratulated Dr. MacPherson on his able presentation of this very interesting subject. He himself had never had a case of asthma following operation on the ethmoid cells, but had seen two cases of asthma complicated by ethmoiditis. In one case there were polypi. In both cases operation was performed on the ethmoid cells, but the asthma was not relieved. This, however, did not change his opinion that the asthma was due to the ethmoiditis, for the irritation of the scar tissue following the operation may have kept up the reflex neurosis. It is generally conceded that a reflex neurosis is developed from a perverted nerve impulse. The nerve supply of the ethmoidal labyrinth comes from the first branch of the trigeminus. It is interesting to trace the course of the impulse that would come from the ethmoid cells. It would go to the medulla and would there be transferred through association fibres to the vagus, whence it would be directed to the trachea and bronchi through the thoracic branches of the vagus. When the reflex neurosis is continued for a length of time, it is difficult or impossible to divert the nerve impulse from the perverted nerve track, and that is why operation on both these cases was of no avail.

He asked if Dr. MacPherson could discover in any of his patients either a personal or a family history of hay-fever. It is well known that where a patient has an hereditary history of hay-fever—where members of the family are hay-fever subjects, some of them will develop asthma.

DR. QUINLAN said that he had always been taught to regard asthma as a spasm of the bronchial muscles, but in the last few years he seems to consider it a vaso-motor paralysis, producing a condition in the trachea which penetrates into the tubes, like a vaso-motor rhinitis. Many of these cases subside under a vaso-motor constrictor—cocaine, or adrenalin. Some of them have come wheezing into his office, and under such astringent, stimulating influences as those referred to the breathing in a short time would become normal. In other instances this so-called asthma is more or less neurotic in type. One patient had a very sympathetic husband: whenever she had a discordant word with her husband she would

have one of these attacks of wheezing until his apparent anxiety would quiet her attacks.

All of these conditions which show themselves in the respiratory tract have a peculiar and personal equation, and should be studied individually as well as collectively. Everyone who has seen cases where hypertrophies, polypoid degenerations, adenoids, growths from the base of the tongue, etc., have been removed will remember that his patients have been relieved immediately. The cases that Dr. MacPherson has just mentioned, with uric acid diathesis, form an individual group, but there is no class of cases that must be so studied and watched as the neurotic, vaso-motor, or cardiac group. Some of these have manifestations that must be treated by attention to the nasal tract and alimentary tract.

Dr. Coffin in a very beautiful and classical essay referred to the effect of diet and disturbances of the alimentary tract, and has shown that a marked significance in these conditions is due to errors of digestion. Some patients will tell you that the moment they eat a nut—almond, walnut, etc.,—there is at once an excitation of this nervous group and they are thrown into a paroxysm. He has at present three patients who cannot eat a single bit of nut-meat—almonds, walnuts, or pecans. Whether there is an emanation from the nut that excites the delicate fibres of the naso-pharyngeal tract, or whatever the reason, they are excited and the most violent paroxysm is the result.

Dr. H. L. Wilson said that he had never seen a case of asthma following operation on the nose who had not been attacked before, until recently, when he thought he came across such a case in a young woman of 19, who had a very severe attack of asthma after the removal of the middle turbinate. That night her physician had to give her repeated doses of morphine to relieve her. She said that she had never had an attack of asthma in her life, but her mother said that when she was about nine years of age she had a very severe attack. So it seems probable that in all of these cases where asthma occurs after operation there is some predisposition to it.

Dr. Berens said that he had seen many cases of asthma of nasal origin, and that he had seen asthma attacks follow operation on the ethmoidal cells. These cases, however, had had previous asthmatic attacks, or presented family histories of asthma, or had some constitutional condition or diathesis, such, *e. g.*, as gout. If asthma is a prolonged sneeze, as he believes it to be in this class of

cases, it is not difficult to understand why some cases after operation have asthmatic attacks. Granulation tissue, the formation of which usually accompanies healing, if in excess is a frequent cause.

DR. CORWIN said that he had had no experience of this kind in his own practice, but curiously enough only a few days ago a woman whom he had been treating for asthma for a year, had told him that her first attack came on after an operation which had been performed in her nose by a colleague. As he understood, that same night, about a year and a half previous to this date, she attended a clinic for some trouble with the throat and ear, and after she had had treatment for two or three weeks, attention was drawn to the fact that she was not using her nose for respiration, and she said she had never used it, but had always breathed through her mouth, and thought that was the only way to breathe. The operation had consisted in removing a small piece of tissue from the right naris, and the operator removed other portions of tissue subsequently. She was no better as to her nasal condition. She came under Dr. Corwin's care about a year ago. Both nares were almost entirely occluded, and she was a confirmed mouth-breather. He immediately proceeded to remove the tissue, including a number of polyps around the middle turbinate region. He removed all of the right middle turbinate, the hypertrophied posterior tip, the lower turbinate on the right side, some of its under portion and like parts on the other side For a while this appeared to provide adequate breathing space. But later there was found a mass of (carious bone* and) granulation tissue about the sphenoidal sinus orifice. The sphenoid wall was broken down and the granulation tissue curretted away. The asthma then left her for a couple of months, but this period corresponded with the warm season of the year, July and August. It returned with the cool nights, and has since continued in all its severity. She has perfect respiration through both nares now and a clear passage for the breath. There is no discharge, and she gets along comfortably during the day. Her asthma can always be relieved by the use of one of the asthma powders, which she burns for an hour or so. Sometimes she has to resort to it two or three times in the course of the night.

This is an instance of asthma coming after the removal of tissue from the nose, the nose however, never having been used much throughout her life. She is a woman of fair intelligence and her

*Reference to the carious bone should have been made when the granulation tissue was mentioned. It is added now, after examination of the written history of the case.

general health is excellent. The nose is small, however, and the nares not very large.

DR. EMIL MAYER said that the question is one of extreme importance. Is it possible for such results as the speaker had presented to occur? If laryngologists and rhinologists were asked if they had ever noticed such results, most would say that they had never seen anything of the sort. (One of the three cases the reader himself throws out, one he has some doubts about, and that leaves but one that he considers authentic). It is a new question for thought and consideration. Heretofore it has always been considered that the obstructions were the prime cause of the asthma, and it is important for us to be prepared to inform our patients that we may make them worse rather than better by operation. For this reason the matter should be carefully studied and sifted down as to whether there is any family tendency, or tendency for anything like hay-fever or asthma. If such results are likely to follow our operative treatment, it is well for us to know it.

DR. MACPHERSON, replying to Dr. Berens, said that he realized the difficulty of eliminating all causes of asthma in any given case, but in two of the cases reported in the paper no cardiac, renal, digestive or other reflex cause could be found to account for the trouble. As stated in the paper, several competent men had gone over two of the cases with negative results. This would answer Dr. Mayer also.

As convincing as the etiology by exclusion was the uniformity in point of time at which the asthmatic symptoms made their appearance after the operation.

In the case of the private patient reported, one sister had had an attack of asthma. There was no history of hay-fever in any of the cases.

PRESENTATION OF SPECIMENS.

Angioma of Tonsil. By T. P. BERENS, M. D.

DR. BERENS said that he had hoped to present the pathological specimen to-night, but that it was so destroyed by the cautery as to render examination unsatisfactory. He presented, however, a picture, made just previous to the operation by Dr. Braun, of what undoubtedly was a cavernous angioma of the tonsil, perhaps one and one-quarter inches long, half an inch broad, and one-third of an inch thick. It extended from the anterior superior limit of the tonsil to its inferior border, and from behind the anterior pillar to

behind the median line of the tonsil. By pulling the anterior pillar forward the limit of the growth could be outlined, and by rotating the tonsil forward the posterior limit could be located. The extreme lower limit of the growth was almost a typical naevus in appearance.

Ligation was done with a needle and catgut at the superior border of the growth, and the growth was removed by the galvano-cautery without hemorrhage, and the patient made an uneventful recovery, going home in a week. Both Dr. Jonathan Wright and Dr. Harmon Smith saw the case and concurred in the diagnosis.

These growths on the tonsil are rather rare, and this was the only one of the kind that he had seen in twenty years, although he had seen a very large one extending over the tongue the year before that.

DR. LEDERMAN said that he had recently seen a pulsating tumor, occupying the right side of the pharyngeal wall, behind the posterior pillar of the fauces, in a woman sixty-five years of age. It extended from below the base of the tongue up to the soft palate. The pulsation was synchronous with the heart-beat. When full of blood, it measured about three quarters of an inch in diameter. The patient did not complain of any annoyance from its presence. She had a reflex cough, due to an enlargement of the lingual tonsil, which symptom was relieved by treatment to this tissue. A small lingual varix at the base of the tongue was also present. The pharyngeal lesion was evidently an aneurism of the ascending pharyngeal artery. The patient was warned of the danger of having the wall of the aneurism injured by local treatment or foreign substances. She had been seen by a well known laryngologist, who had not mentioned its existence.

DR. BERENS said that his tumor had no pulsation. It had caused no symptoms and was discovered accidentally. It was removed because of the apparent danger of hemorrhage, owing to the thinness of the walls of the growth.

PRESENTATION OF INSTRUMENTS.

DR. COFFIN presented a forceps tonsil snare, a modification of Bosworth's old snare, and explained its advantages.

A New Laryngostroboscope for Observing the Separate Vibrations of the Vocal Cords. By E. W. SCRIPTURE, M. D.

The laryngostroboscope is an apparatus for throwing intermittent flashes of light into the larynx in such a way that the vocal cords appear to vibrate slowly. The form of the vibration can be studied as it varies in different tones, registers and diseases.

A beam of light from a strong arc lamp is made to pass through the holes of a large aluminum disc which rotates rapidly. The speed of the disc is adjusted by a rheostat attached to the motor. This intermittent beam is reflected into the larynx in the usual way.

A blast of air directed against the holes in the disc produces a tone. When the patient sings the same tone as that produced by the disc, his cords are vibrating the same number of times that the holes pass in front of the arc light. For example, when 256 holes pass in front of the blast the tone of middle C is heard. At the same time 256 flashes are thrown down the larynx. When he sings the same tone, his cords vibrate 256 times. Observed in the throat mirror, they appear to stand still. If he sings a trifle higher, say 257 times, the cords appear to execute a slow vibration of once a second.

Various observations on the action of the cords were mentioned; details were reserved for a later occasion.

The Influence of Nasal and Post-Nasal Obstruction in Children.

L. W. DEAN, Iowa City, Ia., *Medical Herald*, Dec., 1908.

As results of such obstruction, the author describes disturbances along the respiratory tract, of the ears, nervous system, nutrition, and of the teeth, jaw, and bones of the face. Of the last, he remarks: "Not only is nasal obstruction the greatest and most frequent cause of malocclusion of the teeth, but malocclusion, which is identical with undeveloped maxillary part of the nose, in turn increases nasal deformity."

He would remove post-nasal obstructions before orthodontia is attempted, but, as turbinate tissue has a most important function, he objects to trimming it in children, until malocclusion of the teeth has been repaired, and thus widening of the palatal arch and nose secured. Perfect occlusion of the teeth stimulates the arrested development of all the bones beneath the orbit, providing the work is done early in life. EATON.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY.

Regular Meeting, February 9, 1909.

HENRY GRADLE, M. D., Chairman.

PRESENTATION OF CASES.

Traumatic Dislocation of the Nose and Upper Lip. By W. L. BALLENGER, M. D.

DR. BALLENGER reported a case of a man who was carried two hundred feet by a cyclone, falling violently on his face. The nose and upper lip were severed from the face, and in healing the nasal vestibule rested opposite the gums, with the result that there was complete occlusion on one side and a very small opening on the other. As the result of operative intervention, the man has now perfect breathing space, and his appearance has been somewhat improved.

Report of a Case of Rhinoscleroma. By S. A. FRIEDBERG, M. D.

Female, age 21, born in Austrian Poland. First came under observation in February, 1908. Illness had begun about four months previously with a sensation of dryness in the nose. A month later the laryngeal symptoms developed. These consisted of dryness, cough, increasing hoarseness and dyspnoea. The first examination showed marked nasal involvement confined principally to the turbinals. No external lesions. Nasopharynx slightly involved. Marked subglottic involvement with limitation of the movements of the vocal cords. Palliative treatment with bougies carried on for about two months when tracheotomy had to be performed. Patient wore a tube for nine months. This has recently been removed. In addition she has had X-ray treatments. Examination at present shows the process in the nose to have reached the terminal stage of contraction. There has been no extension in the nasopharynx. A nodule is found on each posterior pillar in the pharynx. The subglottic swelling has diminished greatly so that now there is practically no obstruction to the entrance of air. The movements of the vocal cords have been restored to a considerable degree, the right more than the left. Whether the X-ray treatment or the rest obtained by the larynx through the wearing of the tube has brought about the improvement it is impossible to say.

Likewise it remains to be seen whether the improvement will be permanent.

Dr. J. C. Beck saw Dr. Friedberg's case of rhinoscleroma before the treatment was begun, and notes a decided improvement. In a case which he had previously seen in Prague, the objective findings were not so marked as in Dr. Friedberg's case. A positive diagnosis in these cases is made when one finds the exciting cause. In cases of ordinary papilloma of the vocal cords, Dr. Beck has obtained very good results by forcing physiological rest and inserting a tracheotomy tube.

Dr. F. G. Stubbs referred to a case of rhinoscleroma which he presented to the Society two years ago. In this case a very small triangular opening was the only passage through the larynx. When mucus filled this opening, the patient could hardly breathe. He dilated with Schroetter's tubes up to No. 3, continuing the dilatation for two months. X-ray was also used, but no improvement noted. She was seen a year later, when the conditions remained as they were after the dilatation.

Dr. E. L. Kenyon considers that the tawny color of the mucous membrane and the subglottic infiltration are characteristic of rhinoscleroma. He used the X-ray on a case where the soft palate was extensively involved, but failed to note any effect, although the treatment was continued a long time. The improvement which did occur he thought was due rather to the enforced physiological rest. While it is a fact that rhinoscleroma of the outer surface of the nose has been decidedly improved by the X-ray, he does not hold that the mucous membrane of the larynx would be similarly affected by the rays passing through the cartilage.

Dr. O. T. Freer does not consider the subglottic infiltration particularly characteristic of rhinoscleroma. He has frequently seen just such swellings in tuberculosis of the larynx.

Dr. J. R. Fletcher has recently seen a number of cases of rhinoscleroma in Vienna, and thinks the findings of Dr. Friedberg's case are sufficiently characteristic to warrant a diagnosis even without the histological findings.

Dr. Friedberg, in closing, stated that he had employed dilatation for several months, but had only succeeded in introducing a No. 2 Schroetter bougie. The obstruction was so great that he was forced to do a tracheotomy. In regard to the use of the X-ray in the case referred to by Dr. Kenyon, he is of the impression that the disease had practically reached the terminal stage before the X-ray was

applied, and one could hardly expect any treatment to prove effectual under those conditions.

Laryngeal Case for Diagnosis. By S. A. FRIEDBERG, M. D.

The patient, a man of 40, first noticed hoarseness about four years ago, which has steadily grown worse. A fair sized bougie can be passed without difficulty. There is an infiltration at the anterior end of the left vocal cord, which appears to be cystic, but no fluid could be withdrawn through the aspirating needle. Infiltration presses the vocal cord outwards.

DR. H. KAHN does not consider the case a malignant one, but thought the diagnosis of a myoma was suggested both by the history and the slow growth of the tumor.

Cavernous Angioma of the Buccal Cavity. By R. H. GOOD, M.D.

DR. GOOD presented a girl who, since her birth, has had a tumor on the inner aspect of the right cheek, extending from the angle of the mouth back to within one-half inch of the anterior pillars of the fauces. Its color was bluish and surface quite irregular. By pressure, the size could be diminished at least one-half. There was no pulsation, no pain or discomfort. Mastication is not interfered with, and there have never been hemorrhages.

Dr. Good also exhibited two illustrations of a case of angioma of the tongue.

DR. JOSEPH C. BECK (in discussion) referred to a case of angioma of the cheek involving the soft palate, which he presented to this Society four years ago. This case had been operated upon by Dr. Senn, without securing relief, and later by Dr. Beck. Injections of hot water had failed.

Dr. Carl Beck operated on these cases by inserting interrupted catgut ligatures into the mass, tying these only sufficiently tight to produce gradual starvation of the tumor, and not actual necrosis. Radium had been found of no value in these cases.

DR. H. KAHN referred to a case of bleeding polyp in the nose, upon which he had operated by means of a purse-string suture around the pedicle of the tumor. After cutting off the polyp the ligature had slipped, and the hemorrhage that had ensued was so severe that it took four hours before he succeeded in checking it.

DR. A. H. ANDREWS stated that he would do one of two things in these cases of angioma,—either ligate the vessels that enter the mass and then employ negative galvanism, or else let the tumor alone.

DR. BALLENGER would use positive galvanism instead of the negative because what the tumor needs is coagulation and not liquefaction. If he would use galvanism at all, he would use several needles at once, with about twenty-five milliamperes of current for five or ten minutes, continuing applications from time to time, as seemed necessary.

DR. J. G. WILSON exhibited an anatomical preparation showing dissection of the muscles around the mouth of the esophagus. This preparation showed a small triangular area just beneath the inferior constricture of the pharynx, in which the muscle fibers were entirely absent. Dr. Wilson called attention to the work recently published by Killian on the anatomy of this region, and pointing out the weakness of this particular area as an important etiological factor in the production of esophageal diverticulum.

DR. J. C. BECK inquired of Dr. Wilson how he would account for the formation of a lateral esophageal diverticulum if the esophageal pouches were the result of the stretching of the weakened area in the middle of the posterior wall as described by Dr. Wilson. Dr. Beck referred to a case of lateral diverticulum of the mouth of the esophagus which he had filled with bismuth for diagnostic purposes.

DR. STUBBS inquired of Dr. Wilson how long a spasm of the superior constrictures usually lasted. He had seen a case recently in a man forty-seven years of age, where the spasm persisted for twenty-four hours.

DR. KENYON had seen a case several years ago in which the spasm was so severe that the patient was unable to swallow anything, and it was impossible to pass a bougie for over twenty-four hours.

DR. WILSON, in closing, stated that he did not know what the usual length of time was that the spasm persisted. A spasm of moderate severity had been known to last for several days. Severe spasms usually pass more quickly. In the case of lateral diverticulum cited by Dr. Beck, he thinks it very likely that the mouth of the diverticulum was posterior, but that the sac had been pushed to one side on account of the anatomical relations.

A DISCUSSION OF THE PHYSIOLOGY OF THE COCHLEA.

DR. GEO. E. SHAMBAUGH, in discussing the physiology of the cochlea, called attention to the existence in the labyrinth of three distinct types of end organs: the macula acustica in the vestibule, the crista acustica in the semicircular canals and the organ of

Corti in the cochlea. The older physiologists looked upon the labyrinth of the ear as a mechanism solely interested in sound perception, and they distributed this function over these three types of end organs as follows: Tone perception to the organ of Corti, noise perception to the macula acustica, and the ability to determine the direction from which sound comes to the crista acustica. The physicists have been able to demonstrate that no fundamental difference exists between a tone and a noise, so that the necessity for two types of end organs in sound perception is uncalled-for. It has also been demonstrated by physiological research that the semicircular canals have a function quite distinct from that of hearing. The present view is that all sound perception takes place in the cochlea, whereas the end organs in the vestibule and in the semicircular canal have to do with the function of equilibrium.

When Helmholtz undertook the study of tone perception, his efforts were directed to the explanation of the most conspicuous phenomenon connected with tone perception, that of tone analysis. If a number of tones are sounded at the same time, the complex wave that impinges upon the organ of hearing is analyzed by this organ into its component parts, so that we are able to recognize each of the original tones. This phenomenon of tone analysis has an every-day analogy in the principle of physical resonance. If, for example, a number of tones are sounded in an open piano forte, the complex wave that impinges upon the piano strings will be analyzed by these strings, so that the strings in the piano corresponding to each one of the original tones will be set to vibrating. This fact suggested to Helmholtz that a similar mechanism of physical resonators existed in the cochlea, arranged in such a way that in the perception for the high tones there would be a response in one part of the cochlear tube, and for the low tones in another. Helmholtz then examined the cochlea in order to find, if possible, a structure which would fit this theory. The rods of Corti appeared to him as structures which might take up the function of rod resonators. This idea had to be given up when it was shown that in birds and crocodiles the rods were wanting. Helmholtz then selected the radiating fibers of the membrana basilaris as the resonators. These fibers, longer at the apex of the cochlea, should respond to the low-pitched tones, while those at the base of the cochlea, being shorter, should respond to the high-pitched tones and in vibrating bring about a stimulation of the superimposed hair cells. Various modifications of the theory of tone perception that have been suggested since the time of Helmholtz all retain the

idea that the active structure in bringing about a stimulation of the hair cells is the membrana basilaris.

Dr. Shambaugh's work on the problem of the physiology of the cochlea was undertaken from quite a different viewpoint. He became primarily interested in the embryology and in the histology of the end organs found in the labyrinth. A study of the internal ear in this way leads to conclusions regarding the function of the various structures in the organ of Corti which are different from those reached by Helmholtz.

From a study of the development of the labyrinth it is found that the three types of end organs which are located in the internal ear all have a common origin in the primitive otic vesicle. A careful study of the histological details of these three end organs shows us that fundamentally they have exactly the same structure, that they are made up of peculiarly specialized epithelial cells, which have hair-like processes, and that above these hair-cells there is suspended in each instance a peculiar structure derived from the epithelium. This similarity suggests very strongly that they are all three derived from a common primitive end organ. This overhanging epithelial structure in the vestibule is the otolith membrane. In the semicircular canals it is the cupula, and in the cochlea it is the membrana tectoria. The stimulation of the hair-cells in each instance is brought about by an interaction between the hairs of the hair-cells and this overhanging epithelial structure. Now it is clear that this interaction is brought about both in the vestibule and in the semicircular canals by a movement in the otolith membrane and the cupula respectively. It is therefore logical to assume that in the organ of Corti the interaction between the hair-cells and the membrana tectoria is accomplished rather by the movements of the membrana tectoria than of the membrana basilaris.

If we subject the membrana basilaris to a critical study, we will find a number of conditions which make it impossible for this structure to perform the function of resonator as embodied in the Helmholtz theory. In the first place, this structure disappears as a vibrating mechanism at some distance from the beginning of the basal coil. In the second place, if this membrane consisted of a series of string resonators, we would expect to find that as the fibers become shorter, they would also become thinner. Just the opposite is the case. Invariably the shorter the fibers become, the thicker they become. In the third place, there is attached to the under surface of the membrana basilaris a blood vessel which

must dilate or contract, depending upon the blood pressure. This would interfere fundamentally with the principle of the Helmholtz theory, which requires that each radiating fiber must always vibrate for the same tone. The logical conclusion from these facts seems to be that the membrana tectoria, and not the membrana basilaris, is the active agent in stimulating the hairs of the hair cells.

Just how the membrana tectoria responds to the impulses of the various tones passing through the endolymph is not easy to determine. Any conclusion as to its probable action must, of course, be more or less speculative. Of the possible modes of action, three suggest themselves. One is that for each tone the whole membrane is thrown into action. The second is that the high tones stimulate but a small part of the tectorial membrane at the beginning of the basal coil, and that each tone lower in the scale stimulates a larger and larger part of the membrane. The third is that the membrana tectoria responds in its several parts to tones of different pitch, in the basal coil for the high-pitched tones, and in the upper coils for the lower tones. In order to determine which hypothesis is the probable one, we must keep in mind the phenomena that must be accounted for. These are, in the first place, the phenomena of tone analysis; in the second place, the so-called secondary phenomena of tone perception, and finally the occurrence of tone islands. The phenomena of tone analysis can possibly be accounted for by any of the three hypotheses. The secondary phenomena of tone perception are accounted for most plausibly if we assume the third mode of action. Finally, the phenomena of tone islands, or of defects in the middle of the tone scale, can, it seems, be accounted for plausibly only on the assumption that the membrana tectoria responds in its several parts to tones of different pitch, thus acting in the manner of a physical resonator. The final conclusions are that the membrana tectoria is the agent which by responding to the various tone impulses passing through the endolymph, stimulates the hair-cells of the organ of Corti, and brings about tone perception. The manner in which the membrana tectoria responds to the various tones appears most probably to be by separate segments responding to different tones, —the high-pitched tones in the basal coil, the lower tones in the upper coils.

Dr. Holinger inquired whether the anatomical facts relating to the membrana basilaris which Dr. Shambaugh cited, were those found in embryonic specimens, or from specimens taken from normal-hearing human adults. He stated that the point has been made

that the mechanism of hearing is not the same in man as in animals. If this is true, conclusions based on anatomical data derived from the lower animals could not safely be applied to the function of hearing in man. He thinks that the tectoria membrane is a soft structure that is more suited to dampen the sounds rather than intensify them, somewhat rather like the soft pedal on the piano. It was not clear to him how the same hair-cells in the organ of Corti, even when grouped differently for different tones, could result in tone analysis, as Dr. Shambaugh had pointed out.

Dr. J. G. Wilson emphasized the fact that Dr. Shambaugh had arrived at his conclusions regarding the physiology of the cochlea by beginning with a study of the embryology of this organ, and continuing with a painstaking study of the adult anatomy, and that finally his work led up to a discussion of the probable physiological function of the structures. This method of procedure is now recognized to be the proper scientific method for working out any new question in physiology.

Dr. Shambaugh has been an enthusiastic worker on the labyrinth of the ear, and Dr. Wilson thought this enthusiasm might perhaps be urged as objections to his results. Dr. Wilson stated he still was a believer in the telephone theory, which in the discussion Dr Shambaugh referred to as a discarded theory. He thinks the telephone theory as we now see it, as well as the resonator theory of Helmholtz, as understood to-day, is quite different from either of these theories when they were first brought out. He said that Dr. Waller, of London, was a prominent exponent of the telephone theory to-day. This theory refers the ultimate analysis to the brain.

Dr. Shambaugh's anatomical points have been substantiated by other workers. There are still some questions where difference of opinion exists. If he understood Dr. Shambaugh correctly, the hair cells in the three types of end organs found in the labyrinth are peculiar in the histology of these special sense end organs. This may not be strictly true, since there are other end organs with hair-like filaments. He does not believe that the ear is capable of recognizing absolute pitch.

Dr. H. Gradle considers the work by Dr. Shambaugh as in a measure a corroboration of the fundamental hypothesis of the Helmholtz theory of tone analysis. The workers on the cochlea are to-day in possession of more detailed anatomical knowledge than was Helmholtz. On the other hand, Helmholtz was a master in physics, and it was this knowledge that made it possible for

him to construct his work on the hypothesis of tone analysis. He thinks the fact that the membrana tectoria is not a homogeneous structure, but a very complex one, is an evidence that it may be possible for its different units to analyze the impulses from the various tones which pass through it into the hair-cells. Any theory to-day which refers tone analysis to the labyrinth must necessarily also take into consideration the well-known pathological phenomena. One is that the labyrinth may be thrown out of tune by certain diseased conditions producing the well-known condition of diplacousis. This condition seems to be produced sometimes in cases where there is evidence only of a slight middle ear catarrh.

Dr. Andrews thought that there was a somewhat similar condition of things in the eye, although the media through which impressions were carried is different. He thinks it is possible to conceive of sound waves passing through the fluids of the labyrinth affecting the hair-cells directly without the intervention of either a membrana basilaris or a membrana tectoria.

Dr. Shambaugh, in closing, replied to Dr. Holinger's question. The anatomical material from which the data regarding the basilar membrane had been derived was the new-born pig, which represents the adult condition, since the labyrinth, like the other special sense organs, is fully matured some time before birth. He does not believe there is any reason to doubt but that the fundamental facts regarding the function of hearing is the same for the lower animals as for man. Where structures are so alike throughout there is no reason to believe that a different mode of function exists in one species from that in others.

Dr. Holinger's fear is hardly warranted that a confusion of tones must arise where the same hair-cells are stimulated for different tones only in different groups. From the standpoint of the psychologist, all that is necessary to account for the phenomena of tone analysis is that there should be a different group-complex of hair cells stimulated for each particular tone.

Dr. Wilson's suggestion that an enthusiastic worker is liable to draw false conclusions, is hardly to the point. Enthusiasm is always necessary to accomplish any painstaking work. The question is rather whether one is able to recognize anatomical facts as they exist, and whether one is capable of drawing logical conclusions from established facts.

The hour was already so late that he thought it would not be feasible to take up the discussion of any further points.